

367



HANDBOOK  
OF THE  
9.2-INCH B.L. GUNS,  
MARKS IX, X, AND XV.  

---

(LAND SERVICE.)

---

1906.

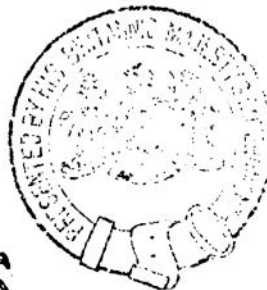
1936.04  
W19

HANDBOOK  
OF THE  
9·2-INCH B.L. GUNS,  
Marks IX, X, and X<sup>v</sup>.



LAND SERVICE.

1906.



LONDON:  
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,  
BY HARRISON AND SONS, ST. MARTIN'S LANE,  
PRINTERS IN ORDINARY TO HIS MAJESTY.

And to be purchased, either directly or through any Bookseller, from  
WYMAN AND SONS, LTD., FETTER LANE, E.C.4; or  
OLIVER AND BOYD, EDINBURGH; or  
E. PONSONBY, 110, GRAFTON STREET, DUBLIN.

*HJ* Price One Shilling and Sixpence.



# CONTENTS.

	PAGE.
Guns .. .. .	3 to 5
Breech Mechanism, Mark IX Gun .. .. .	5
Obturation and Firing Mechanism, Mark IX Gun .. .. .	6
Breech Mechanism, Marks X and XV Guns .. .. .	7
Obturation, Marks X and XV Guns .. .. .	8
Firing Mechanism, Marks X and XV Guns .. .. .	9
Weights and Dimensions of Obturating Pads .. .. .	10
Removing and replacing Breech Mechanisms .. .. .	11 to 13
Examination of Breech Mechanisms .. .. .	13
Box, spare parts .. .. .	14
Appurtenances (sights) .. .. .	14
Obturator Pad Boxes .. .. .	15
Implements .. .. .	16
Side Arms .. .. .	18
Instructions for Care and Preservation of Guns .. .. .	19
Rifle, Aiming .. .. .	19 to 22
Carriages .. .. .	22 to 50
Instructions for Care and Preservation of Carriages .. .. .	50 to 54
Instructions for Use, Care, and Preservation of Electric Firing Gear .. .. .	54
Pumps, running back, Portable .. .. .	56
" Air or Liquid .. .. .	57
" Air, Double .. .. .	59
" testing Compressed Air Reservoirs .. .. .	60
Reservoirs, Compressed Air .. .. .	61
Separator .. .. .	63
Gauges, Pressure .. .. .	63
Gauge, Pressure, Dead Weight testing .. .. .	64 to 68
Cartridges .. .. .	68 to 71
Projectiles .. .. .	72 to 75
Extractors, Drill Shell .. .. .	75
Fixing Plugs and Fuzes, &c. .. .. .	76
Fuzes .. .. .	76 to 83
Tubes .. .. .	84 to 86
Range Tables .. .. .	87 to 122
Drill .. .. .	123 to 138

## PLATES.

	PLATES.
Guns .. .. .	i and ii
Breech Mechanism .. .. .	iii " iv
Locks .. .. .	v " vi
Boxes, Obturating Pads .. .. .	vii
Extractor, Tube, Special, box slide A .. .. .	viii
Rifle, aiming .. .. .	ix
Carriages .. .. .	x-xxvii
Pistol Grip, Mark III .. .. .	xxviii
Pumps, running back .. .. .	xxix
" Air or Liquid .. .. .	xxx and xxxi
" Air, Double .. .. .	xxxii " xxxiii
" testing Compressed Air Reservoirs .. .. .	xxxiv
Connection, four-way, Air Pump .. .. .	xxxv
Reservoir, Compressed Air .. .. .	xxxvi
Gauges, Pressure .. .. .	xxxvii
Gauge, Pressure, Dead Weight testing .. .. .	xxxviii
Cartridges .. .. .	xxxix-xliv
Projectiles .. .. .	xlv-xlviii
Fuzes .. .. .	xlix-liii
Tubes .. .. .	liv-lvii

Particulars of 9·2-inch Guns of earlier Marks, and their Mountings, will be found in a separate Handbook.

# HANDBOOK

## OF THE

### 9·2-INCH B.L. GUN,

Marks IX, X, and XV.

(LAND SERVICE.)

[NOTE.—This Handbook is corrected up to March, 1906. Any alterations which may be suggested should be forwarded to the Chief Inspector, Royal Arsenal, Woolwich.]

PUBLIC LIBRARY OF VICTORIA

	MARK IX.	Mark X and XV.
Material .. ..	Steel (wire construction)	Steel (wire construction).
Length, total .. ..	445·25 inches .. ..	442·35 inches.
Weight .. ..	27 tons .. ..	28 tons.
Preponderance .. ..	Nil* .. ..	Nil.
Bore { diameter .. ..	9·2 inches .. ..	9·2 inches.
length .. ..	430·0 inches .. ..	429·33 inches.
capacity .. ..	32,426 cubic inches. ..	32,235 cubic inches.
Chamber { diameter .. ..	13 inches, largest. ..	13 inches, largest.
length .. ..	9·8 „ smallest .. ..	10·2 inches, smallest.
capacity .. ..	71·215 inches .. ..	71·0 „
system .. ..	8,123 cubic inches .. ..	8,123 cubic inches.
	Polygroove, plain section	Polygroove, modified plain section.
Rifling { twist .. ..	Straight from breech end of rifling to 303·585 inches from the muzzle, the remaining 303·585 inches increasing from 0 to 1 turn in 30 calibres at muzzle	Straight from breech end of rifling to 303·585 inches from the muzzle, the remaining 303·585 inches increasing from 0 to 1 turn in 30 calibres at muzzle.
length .. ..	354·685 inches .. ..	353·8 inches.
grooves { number .. ..	37 .. ..	37.
depth .. ..	straight, 0·08 inch .. ..	straight, 0·08 inch.
width .. ..	twist, 0·06 inch .. ..	twist, 0·06 inch.
	straight, 0·62 inch .. ..	straight, 0·62 inch.
	twist, 0·602 inch .. ..	twist, 0·602 inch.
Means of rotation .. ..	Driving band .. ..	Driving band.
Venting .. ..	Axial .. ..	Axial.
Angle of deflection for drift	3 degrees .. ..	No sights on gun.
Radius of sights .. ..	87 inches .. ..	
Firing mechanism .. ..	Percussion and electric ..	Percussion and electric.
System of obturation .. ..	Pad .. ..	Pad.
Ballistic { muzzle velocity { 2,601 = 100 lb. charge		2,643.
effects, { in foot-secs. { 2,643 = 103 „ „		
with { muzzle energy { 17,826 = 100 „ „		18,410.
full { in foot-tons { 18,410 = 103 „ „		
charge { penetration of { 27·5 = 100 „ „		28·83.
W.I. at 1,000 yds. in inches	28·83 = 103 „ „	

\* Nos. 134, 135, and 140 guns have breech preponderance, all others have a counterpoise at the muzzle; in some cases this is shrunk and screwed on, in other cases it is formed solid with the A tube in manufacture.

## MARK IX GUN.

(Plate I.)

The gun is constructed of steel, and consists of an A tube, with an inner A tube extending from the seat of the obturator to the muzzle. The inner A tube is secured longitudinally to the A tube by means of corresponding shoulders and a steel breech bush, which is screwed into the A tube at the rear; the breech bush is also prepared for the reception of the breech screw. Successive layers of flat steel wire are wound round a portion of the A tube, the ends being secured to steel rings provided for the purpose. B tube is shrunk round the A tube immediately in front of the wire, extending to the muzzle. Fitted over the exterior of the wire and overlapping a portion of the B tube is a jacket secured longitudinally by means of corresponding shoulders on the B tube, and a screwed steel bush at the rear. A trunnion ring is screwed over a portion of the exterior of the jacket.

The central portion of the chamber is cylindrical, with curved slopes in front, and coned rear.

In future manufacture the front end will be coned to facilitate the ramming home of the projectile. This will also apply to existing guns when passing through ordnance factories for repair.

The exterior of the jacket is prepared with seatings for the reception of the sighting and elevating band. Two metal brackets are fixed to the trunnion ring for the foresights, and two steel brackets for securing the tangent sight clamps, when in position on the gun, are fitted to the sight ring.

A plane for clinometer is prepared on the upper surface of the jacket at the breech.

For breech mechanism, see page 5.

## MARK X GUN.

(Plate II.)

This gun is constructed of steel, and consists of A and B tubes, a series of layers of steel wire, and jacket. In the interior of the A tube is an inner A tube, secured longitudinally by means of corresponding shoulders, and a steel breech bush, which is screwed into the A tube at the rear; the breech bush is also prepared for the reception of the breech screw. Successive layers of flat steel wire are wound round the A tube, the ends being secured by steel rings provided for the purpose. The B tube is fitted over the exterior of the wire, extending over nearly half the length of the gun from the muzzle. The jacket is fitted over the exterior of the wire in rear, and a portion of the B tube, and is secured longitudinally by corresponding shoulders on the B tube, and by a screwed steel collar over the A tube at the rear. The gun is without trunnions. Two projections round the jacket, near the breech, and a key form a seating for the rear band connecting the gun to the mounting; the key is on the under surface of the jacket, and is formed when milling to shape the front projection.

The central portion of the chamber is cylindrical, reduced in diameter with curved slopes in front, and curved at the rear. In future manufacture the front end will be coned to facilitate the ramming home of the projectile. This will also apply to existing guns when passing through Ordnance Factories for repair.

A plane for clinometer was originally prepared on the upper surface of the jacket at the rear, but is now cut in front of the swell on the jacket.

Sighting lines are formed on the horizontal axis of the gun at the breech, and on the horizontal and vertical axes at the muzzle, and in future manufacture axis lines will be cut on the breech end.

A hole is provided in the left face of the bronze end frame for loading tray steady pin.

For breech mechanism, see page 7.

#### MARK XV GUN.

There are only two guns of this description in the service. The gun differs from Mark X in the construction, and consists of an A tube with an inner A tube, both extending the whole length of the bore, the A tubes forming the chase. Layers of flat wire over the A tubes extend from the breech to a little more than half the length of the gun. Over the exterior of the wire is the jacket, having a breech bush screwed into it to take the breech screw.

The breech mechanism is the same as for the Mark X gun.

### BREECH MECHANISMS.

#### MARK IX GUN.

(Plate III.)

##### *Breech-closing Mechanism, Controlled.*

A bronze frame for the attachment of the mechanism is secured to the breech end of the gun by fixing screws.

The breech screw is closed by a parallel screw having six portions of the screw-thread removed longitudinally so as to admit of the breech being closed (when the breech screw is pushed home) by the 12th of a turn.

A bronze carrier ring for supporting the screw, when withdrawn is hinged by a bolt to the bronze frame. To the hinge bolt of the carrier ring is secured a worm wheel which engages with a worm and worm spindle fitted to the lower part of the frame. The hinge bolt is also fitted with a bevel wheel and rack pinion, the former engaging with a bevel wheel with friction roller on the carrier ring, and the latter with the rack on the breech screw, in such a manner that, when the hinge bolt is revolved in one direction, the friction roller engages with a roller path prepared for its reception in the end plate of the breech screw, and turns the screw into the unlocked position; the rack pinion then engages with the rack on the breech screw, and withdraws the latter, the whole being then swung round into the loading position. The reverse action takes place when the hinge bolt is revolved in the opposite direction. A catch is fitted on the breech mechanism frame engaging with a ratchet wheel on the worm spindle in such a manner as to retain the carrier in the "open" or "loading" position.

In the event of accident to the controlling gear, the breech screw may be withdrawn and swung round into the loading position by hand, a cam lever being provided for this purpose. When the cam lever is not in use the recess for cam lever is filled by a preserving block.

*Obturation.*

The system of obturation consists of a circular pad with protecting discs fitting the mouth of the chamber, placed between the head of the axial vent and the breech screw.

For weight of obturators, *see* table, page 10.

*Firing Mechanism.*

(Plate VI.)

The mechanism is so arranged that the gun cannot be fired until the screw is locked in the gun.

The gun is furnished with an axial vent prepared at its outer end for the slide box for lock.

To the hinge joint of the carrier ring, and projecting through the side of the breech screw, is fitted a contact bolt, which is actuated by means of a cam groove in the rack pinion in such a manner that when the breech is closed the contact bolt is forced through the recess in the side of the breech screw, and makes contact with the lower contact of the electric lock. In opening the breech, the first movement of the rack pinion serves to withdraw the contact bolt clear of the breech screw, and thus admits of the latter being unlocked and withdrawn. The contact bolt has fitted to its inner end an insulated contact, rubbing with the lower contact of the electric lock now used with wireless tubes; a length of M. 1 electric cable is passed through the contact bolt and carrier ring; one end is fitted and soldered into the above-mentioned contact, the other end being similarly secured to an outer insulated connecting piece, with elbow piece for the attachment of the electric firing cable; this connecting piece is secured to the right side of the breech-mechanism frame by means of a metal bracket (x, *Plate III.*) and screws. The recess for the cable of the contact bolt in the hinge joint of the carrier-ring is enlarged at the outer end so as to admit of the contact bolt being removed or replaced without making or breaking any soldered joint. A removable filling piece is fitted to the outer end of the recess and secured by a fixing screw.

The following locks are used with the gun:—

Ordnance B.L. 9·2-inch, wire, Marks VIII and IX.

Locks, electric, Marks I\*\*\*, I\*\*\*\*, II\*, and III.

Lock, percussion.

*Electric Firing.*—The electric locks (all of which are interchangeable with Marks VIII and IX guns) are very similar. The Mark I\*\*\* and Mark II\* are the original locks for the Mark VIII Naval Service gun, but now fitted with wire-braided cable instead of a lead with coiled wire protecting cover, and now further brought up to Mark III pattern, while Mark I\*\*\*\* is the original electric lock for wired tubes Mark IX gun, converted for use with wireless tubes, and further brought up to Mark III pattern.

The Mark III electric lock (*Plate VI*) generally consists of a steel frame (a) fitted at the upper end with an actuating lever (b) with sleeve (c) by means of which it is raised or lowered, thus admitting the insertion or withdrawal of the tube from the vent; an extractor (d), and an insulated contact (e); and it is provided near the centre with an insulated aluminium crown metal connecting piece, having at one end a steel centre punch point (f), and connected at the other end by a phosphor bronze braided wire cable to the insulated contact at the lower end of the lock.

The upper contact is encased in a steel cover, actuated by a link

fitted to the lock frame, which engages with the cam portion of the actuating lever, so arranged that, when the lock is in position and the lever depressed, the point of the contact is forced partially into the head of the V.S. tube and contact made. To keep the punch up to its work, a flat steel spring is fitted to the upper end of the lock-frame. The free end of the spring is forked, and engages with the outer end of the upper contact case, which is prepared for its reception.

The "punch" of the upper contact is of such length as to admit of a maximum protrusion of .09 of an inch, and the grooves in the contact case, and corresponding projections on the actuating link, are arranged to withdraw the punch within the face of the firing-hole bush when the actuating lever of the lock is raised.

The under side of the lock is provided with two serrated cutters, which grip the head of the V.S. tube and ensure a clean surface for the earth return.

The lock is secured during firing, by means of a catch on the sleeve of the actuating lever, which engages with a projection on the box slide when the lock is in the firing position. To prevent the lock from sliding out of the slide box when the actuating lever is raised, a stop catch is fitted to the actuating lever which engages with a stop on the lock frame.

When placing the lock in position or withdrawing it from the gun, the bronze nut of the stop catch must be pressed in so as to allow the actuating lever to be raised beyond the stop on the lock frame, as it is only with the lever in this position that the lock can be inserted or withdrawn.

*Percussion Firing (Plate VI).*—The percussion lock consists of a steel frame furnished with an extractor, actuating lever, and stop catch, generally similar to those of the electric lock. The lock frame is fitted with a striker, main spring, trigger, and safety plunger. The striker is cocked automatically when the actuating lever is raised, and maintained in the cocked position by the trigger. The trigger is furnished with a loop for the attachment of the service lanyard. The safety plunger which is fitted to the lower portion of the lock frame serves to ensure that the vent sealing tube is not detonated by the striker before the actuating lever is lowered. When the breech is closed and the actuating lever lowered, the safety plunger is automatically withdrawn from the striker, which is then free to strike the vent sealing tube when the trigger is pulled.

#### MARKS X AND XV GUNS.

(Plate IV.)

##### *Breech-Closing Mechanism ("Welin" System).*

The breech is closed by a parallel screw, which differs from the ordinary interrupted screw in having a larger amount of thread in proportion to its length by arranging segments at various diameters, the breech opening of the gun being prepared in a corresponding manner. The interruptions in the gun are arranged to accommodate the segments of the screw of largest diameter, thus, when the screw is unlocked, these segments pass into the interruptions, and the segments, next smaller in diameter, unlock into the spaces left vacant by the larger ones.

The breech screw is attached to the carrier by means of corresponding interrupted screw threads, and by a steel vent passing

through the centre of the breech screw. The vent has a mushroom head at the inner end, behind which are placed the obturating pad and protecting discs. The vent is retained in position by means of a sleeve, spiral spring, collar and nut, in the carrier.

A manganese bronze carrier for supporting the breech screw is hinged to a manganese bronze frame on the gun by means of a bolt at the right side of the breech. The carrier and breech screw are opened and closed by means of a breech mechanism lever (A), pinion, and link (B). The lever is retained in the closed position by a catch fitted to the underside of the carrier.

Breech mechanism frames are now fitted with clamping nuts in the upper and lower lugs for securing the ball bearing bushes, and corresponding serrations are made round portions of the ball bearing bushes so as to engage with the clamping nuts.

Carriers now made (and others are altered as required) have a recess formed in the outer surface so as to admit of the electric and percussion lock, "E," when fitted with the tripping piece, being placed in position in the gun.

The carrier is retained when in the loading position by a catch which consists of a steel plunger with spiral spring, fitted to a bracket which is attached to the right side of the gun at the breech, the rounded end of the plunger engages in the recess of a hard steel piece which is fitted to the underside of the carrier, near the hinge joint; a pull on the breech mechanism lever releases the catch. A stop for the breech screw when unlocked is formed on the upper side of the carrier by means of a hard steel piece which is secured by two screws, so as to engage with the boss of the "link actuating breech screw."

There is a hole in the left side of the breech mechanism frame for steady pin, and a plate for use with the "catch locking loading tray" is secured by screws.

#### *Obturation.*

This is obtained by means of an asbestos pad and protecting discs, which fit into a coned seating in the gun, as previously described for the Mark IX gun, but which differ in the coned portions being made more acute, the seating in the gun for their reception being arranged at an angle of 13 degrees 14 minutes 48.7 seconds with the axis.

Should the obturator be found not to fit the cone seating in the gun correctly (and this can be ascertained by covering the seating lightly with grease and seeing that the obturator is covered all over, after the breech has been closed and opened again), adjusting discs should be added one by one until the breech closes a little tightly through the obturator being pressed forward into the seating. To admit of the adjusting discs being placed behind the obturator, a clearance of about  $\frac{1}{16}$ -th of an inch is provided in the breech fittings to allow of the vent being moved forward, but the whole of this clearance would seldom be required.

When the obturators require to be changed, care must be taken that the protecting discs issued with the pad are placed in the gun with it. A pad and its protecting discs must, in all cases, be replaced together. For weights, see table, page 10.

When the temperature of a pad in a steep coned obturator is probably less than 50 degrees Fahr., and half charges are about to be used, the pad should be thoroughly softened by immersion in hot water, prior to the practice being commenced.



*Firing Mechanism.**Plate V.*

The firing mechanism is designed for percussion firing, and for electric firing with wireless tubes, and is so arranged that the gun cannot be fired before the breech is closed.

A slide box, (C), in which the electric and percussion lock slides is secured to the outer end of the steel vent (D), the lock being pushed into a position over the vent by means of an actuating link in the rear face of the carrier, when the breech screw is locked in the gun. A safety slide fitted to the lower side of the slide box serves to prevent contact, between the needle of the lock and the electric or percussion tube in the vent, before the breech is properly closed.

An extractor for releasing the vent sealing tube from the vent is fitted to the slide box, and is actuated automatically by the lock in opening the breech. Should the vent sealing tube be so tightly jammed in the vent that the extractor in the slide box fails to remove it, the "extractor, tube, special, box slide, A" should be used. For description, see page 16.

In future manufacture the "box slide, A," will be modified so as to facilitate adjustment of horizontal eccentricity in the gun lock, by arranging the closed end of the box slide, so as to form a stop for the lock when closing the breech.

Existing "boxes, slide, A," when modified, will be described as "Mark I\*," and will be so stamped. New "boxes, slide, A," will be known as "Mark II."

The electric and percussion lock "E" consists of a steel frame with an insulated steel needle (E) which is actuated by a mainspring. The sharp edge on the face of the lock is now rounded off, so as to prevent injury to the head of the vent sealing tube in the vent. For the purpose of percussion firing a cocking handle (F) is provided, by means of which the needle is pulled into the cocked position and retained by the trigger (G), which engages with a projection (H) on the sheath. The trigger can be pulled from either side of the gun by the firing arc (I).

For electric firing, the outer end of the needle of the lock is in contact with the electric firing gear on the carriage (see page 48), the spring contact of the "A" cable being secured in position by means of an elbow piece (J), which screws on to the cocking handle. A spring guide bolt (K) is provided on the lock, which engages with the actuating link in the carrier.

A hook of bull metal, with spring washer and securing screw, is fixed to the carrier for supporting the "A" cable.

The "frame, breech mechanism" is also prepared for the reception of a "hook supporting cable" in order to maintain interchangeability with Naval Service. The hole for the securing screw will be fitted with a plug of greased tow.

*ACTION OF THE MECHANISM.*

*To Close the Breech.*—Turn the breech mechanism lever from right to left, which will cause the carrier with breech screw to swing into the closed position. On continuing the motion of the lever, the screw is turned into the locked position by the link actuating breech screw, which is connected to a stud on the rear face of the breech screw, thus forming a crank. When the screw is locked in the gun the last motion of the breech mechanism lever forces the lock into a central position over the vent by means of the link actuating lock.

*To Open the Breech.*—This is the converse of the foregoing.



## REPLACEMENT LIMITS OF OBTURATING PAD AND DISCS.

*(Slow Coned Obturators.)*

Nature.	Mark of Pad and Discs.	Weight of Pad.		Diameter of edge of steel ring of		Thickness of Pad and Discs, complete.	
		Minimum.	Maximum.	Front Disc.	Rear Disc.	Minimum.	Maximum.
9.2-inch, Mark IX .. .. .	I	lbs. ozs. drms. 4 1 8	lbs. ozs. drms. 4 8 8	inches. 9.8	inches. 9.892	inches. 1.73	inches. 1.8

*(Steep Coned Obturators.)*

Nature.	Mark of Obturator.	Weight of Pad.		Maximum diameter of edge of steel ring of		Thickness of Obturator complete.	
		Minimum.	Maximum.	Front Disc.	Rear Disc.	Minimum.	Maximum.
9.2-inch, Marks X and X <sup>v</sup> .. .. .	I	lbs. ozs. drms. 5 13 4	lbs. ozs. drms. 5 15 12	inches. 10.2	inches. 11.125	inches. 1.885	inches. 1.905
" " .. .. .	II	6 4 4	6 6 12	—	11.122	1.885	1.905

Instructions as to the treatment of pads, &amp;c., that do not come within the above limits, are published in Changes in War Matériel.

## REMOVING AND REPLACING BREECH MECHANISM.

Instructions to be observed in removing and replacing the breech mechanism. Care must be taken not to indent or damage the components: a hammer should never be used unless with a piece of wood or soft metal to transmit the blow: heavy parts, which cannot be lifted by hand, can be slung by salvages, and tackle suspended from the mounting or from any other suitable erection.

The fittings should be examined frequently as to their condition in respect to wear, in order that, if necessary, special examination may be called for.

## ORDER OF REMOVING THE MECHANISM.

Mark IX Gun .. ..	{	1 Lock.
		2 Box, slide.
		3 Obturator.
		4 End plate of breech screw.
		5 Rack.
		6 Breech screw.
		7 Bevel wheel with crank.
		8 Worm wheel.
		9 Carrier ring with details.
		10 Worm spindle.
		11 Cover worm wheel.
Mark X and XV Guns ..	{	1 Lock and box slide.
		2 Vent, axial and obturator.
		3 Breech screw.
		4 Link actuating lock.
		5 Carrier.

Before removing the following fittings, the breech must be opened and the breech screw swung into the loading position, except where otherwise stated.

*Mark IX Gun.*

*Electric, or Percussion Lock.*—Press up the sleeve of the actuating lever clear of the catch on the lock frame, and raise the lever as far as it will go, at the same time pressing the milled head of the stop catch, and slide the lock out of the grooves in the box slide in an upward direction, and withdraw.

*Box, Slide.*—Turn the box slide until it engages with the stop on the end plate, the two portions of the box slide can then be separated to the right and left respectively till clear of the thrust collars on the vent, and withdrawn to the rear.

*Vent, Axial, and Obturator.*—Unscrew the nut from the vent together with the obturator from the front end of the breech screw, the spiral spring and washer belonging to the vent can then be withdrawn from the recess in the end plate of the breech screw.

*End Plate.*—Unscrew the set screw of the cam lever hinge bolt and withdraw the bolt, when the preserving block for cam lever can be removed. Take out the fixing screws of the end plate and remove it.

*Rack.*—To take out the rack, the breech screw must be pushed through the carrier ring into the breech of the gun till the outer face of the screw is almost flush with the breech face of the gun, and turned to the left (by means of two of the fixing screws for the end plate, screwed into opposite holes in the breech screw and used as handles) till the projecting end of the rack comes against the stop on the carrier ring, when the rack can be withdrawn by a straight pull to the rear.

*Breech Screw.*—After the rack has been withdrawn, as previously described, the breech screw must be turned back to the unlocked position in the gun and pulled back through the carrier ring as far as it will go, the retaining clip in the carrier ring being pressed in by means of a piece of wood so as to engage with the groove in the breech screw, the carrier ring at the same time being held in the closed position. The breech screw and carrier ring can then be swung into the loading position and the breech screw withdrawn from the front of the carrier ring, the retaining clip being held clear of the screw by means of a screwdriver used as a lever.

*Bevel Wheel with Crank.*—Unscrew the set screw in the upper right side of the hinge joint, and remove the securing screw of the bevel wheel with crank, when the wheel can be withdrawn.

*Carrier Ring.*—Remove the fixing screw of the cover worm wheel and swing the cover open. Unscrew the set screw in the bottom lug of the end frame. Remove the preserving screw from the upper end of the carrier ring hinge bolt and screw in the eye bolt. Lift the hinge bolt clear of the worm wheel and withdraw the latter. Sling the carrier ring and withdraw the hinge bolt, when the bevel wheel, rack pinion, and contact bolt can be removed from the hinge joint. Withdraw the carrier ring from the end frame, taking care to catch the roller frame with rollers and bearer washers, which will fall out from the underside of the hinge joint.

*Worm Spindle.*—Unscrew the securing nut of the lever and withdraw the latter. Unscrew the set screw in the bracket and withdraw the worm spindle, the worm with the four washers can then be removed from the end frame.

*Cover Worm Wheel.*—Remove the axis pin, when the cover can be withdrawn.

### *Marks X and X' Guns.*

*Lock and Box Slide.*—Draw back the guide bolt of the lock, then turn the lock and box slide through a quarter circle in an upward direction, and remove separately or together.

*Vent Axial and Obturator.*—The axial vent, with spring, nut, and washer, and the obturator, will be removed in the usual way, the sleeve which forms part of the axial vent being removed from the recess in the carrier to the front.

*Breech Screw.*—Disconnect the link actuating breech screw from link pinion by removing the check screw and axis pin, then turn the breech screw on the carrier until the actuating link is clear of its slot, and take off the link. Press the catch retaining breech screw

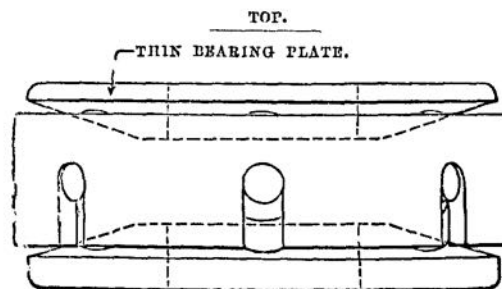
clear of the recess in the breech screw, and turn the latter so as to disengage the screw threads on the interior of the screw from those on the carrier, and withdraw the breech screw. The catch retaining breech screw will then be forced out of its seating by the action of its spring.

*Link Actuating Lock.*—Unscrew the bush of the guide bolt about a quarter of an inch, draw back the guide bolt of the link, and slide the link from its groove in the carrier.

*Carrier.*—Sling this, as a preventative. Remove keep pin and nut from lower end of hinge bolt, and the preserving screw from the top end, replacing the latter by an eye bolt, by means of which the hinge bolt is withdrawn. Release set screw, and unscrew upper ball-bearing bush, and take out the anti-friction balls. Release set screw, and partly unscrew the lower ball-bearing bush, when the carrier can be withdrawn, complete the removal of the lower ball-bearing bush and anti-friction balls. Remove keep pin and nut from breech mechanism levers and withdraw the lever. Remove keep pin and nut from the link pinion stud, and withdraw the link pinion. Unscrew the fixing screws of bracket catch retaining breech mechanism lever, and remove the bracket, remove keep pin and nut, and withdraw catch and spiral spring through hole in bracket.

#### ORDER OF REPLACING THE MECHANISM.

The order in which the mechanism may be replaced will be the reverse of the foregoing. But, however, in the case of hinge bolts having coned roller frame, care should be taken to put the frame in position as shown in the sketch below; the anti-friction rollers being embedded in tallow or other fatty matter, which will serve to retain them while assembling the frame, and afterwards as a lubricant.



#### NOTE.

When examining the breech fittings, care must be taken to test the concentricity of the striker with the tube in the vent. For this purpose a "gauge, striker, eccentricity" is provided, which is suitable to fit in the tube chamber of the vent. In the head of the gauge is a removable plug upon which the position of the striker point is indicated when the striker is cocked, and released with the gauge in

position. If the indent made by the striker point in the gauge is found to be so much eccentric as to be likely to cause miss-fires with either percussion or electric firing, further examination should be made to ascertain the portion of the mechanism in fault, and steps taken to have it repaired or exchanged. This gauge is only issued to I.O.O.'s.

#### BOX, SPARE PARTS.

The box is made of deal, divided into seventeen compartments, and is intended to hold the spare springs and other small parts belonging to the gun.

---

#### APPURTENANCES, &c.

##### SIGHTS.

The Mark IX gun is sighted on both sides, the tangent sights being fitted to a sight ring which is shrunk round the jacket and secured by a set screw, and the foresights into bronze brackets which are attached to the trunnion ring of the gun by fixing screws.

The *foresights* are of the drop pattern, and consist of a pillar, with a small steel acorn point and a sighting blade to facilitate laying, jacket, and socket. The socket is permanently fixed in the gun. The pillar locks into the socket with a bayonet joint, and is secured from turning by a projection on the jacket, which drops into a recess in the socket when the sight is in its true position. The sight cannot be removed without first raising the jacket and turning the pillar round a quarter of a circle.

The sights are "left" and "right" respectively, and are so stamped, the vertical edge of the sighting blade being turned inwards in each case when the sights are in position in the gun.

The Mark I *tangent sights* are of steel, having bars triangular in section, with a rack on the front face gearing with the pinion of the automatic clamp "B," and graduated with a degree scale to 8 degrees, reading to 5 minutes. The rear faces are fitted with aluminium crown-metal range strips, graduated to 10,000 yards for a full charge, with a muzzle velocity of 2,601 ft.-secs. The cross-head is provided with a deflection leaf, having a sighting blade with V-notch for "right" or "left" sights respectively, and is graduated on the lower side with a deflection scale giving two degrees deflection right and left.

An indicating arrow is engraved on the lower side of the deflection leaf to facilitate reading the scale.

The Mark II *tangent sights* differ from Mark I in being provided with traversing screws, and deflection nuts having a quicker pitch. The sights are made right and left for guns on Marks III and IV barrette carriages respectively, each sight having two range strips, one for a full charge, and the other for a three-quarter charge, arranged and graduated thus:—

Mark I range strips	{	for Mark III	{	full cordite charge, 10,000 yds., and M.V. 2,601 f.s.		
		carriage	{	$\frac{3}{4}$	"	" 8,000 " " 2,127 "
		for Mark IV	{	full	"	" 10,200 " " 2,601 "
Mark II range strips	{	carriage	{	$\frac{3}{4}$	"	" 8,000 " " 2,127 "
		for Mark III	{	full composite charge, 10,800 yds., and M.V. 2,643 f.s.		
		carriage	{	$\frac{3}{4}$	"	" 8,400 " " 2,196 "
	{	for Mark IV	{	full	"	" 11,000 " " 2,643 "
		carriage	{	$\frac{3}{4}$	"	" 8,500 " " 2,196 "

Marks X and XV guns are not fitted for sights. For automatic and rocking bar sights, *see* pages 45, and 44, respectively.

#### OBTURATING PAD BOXES.

(Plate VII.)

*Box, Obturating Pads, and Discs, B.L., 9·2-inch. Marks VIII and IX guns. Mark III.*

The box is of wood, the sides being made of deal, ends and bottom of elm, top, battens, and internal fittings of mahogany. The sides are dovetailed to the ends, and the bottom is secured by brass screws. It holds three pads and 3 sets of discs.

The box is fitted with a false lid; a gun-metal bolt passes up through the bottom and both lids, each lid is secured with a fly nut, both nuts being on the before-mentioned bolt. The false lid thus secures the pad and discs in the box (*see* also "Regulations for Magazines, etc.") by having the fly nut screwed down upon it.

Round the top of the box, under the lid, sheet felt is secured with shellac and tacks, to make a tight joint.

On top of the lid there are two metal plates, each having a folding-down handle for lifting purposes, secured by screws; there is also a recess to contain a label of instructions.

The interior of the box is coated with paraffin wax, and the exterior is painted lead colour.

For dimensions, *see* Plate VII.

*Box, Obturator, Steep-coned, B.L. 9·2-in., Marks X and XV Guns.*

The box, Mark I, is of gunmetal; the top has a flanged shoulder, to take the cover. A steel bolt passes up through the box, and a gunmetal nut on the bolt screws down on to the cover, thus compressing the contents. The box holds an obturator and one adjusting disc; it is of the form and dimensions shown in Plate VII.

## IMPLEMENTS.

Description.	Land Service. Marks of Gun for which used.
Bit, vent, 36-inch .. .. .	IX, X and XV.
Borer, tube, chamber { square end .. .. .	IX, X and XV.
pointed end .. .. .	IX, X and XV.
Extractor, tube, special, box, slide A.. .. .	X and XV.
Gauges, striker { eccentricity .. .. .	IX, X and XV.
protrusion No. 3 .. .. .	IX, X and XV.
Ordnance, B.L.—	
Bolt, eye { carrier, hinge bolt .. .. .	X and XV.
hinge bolt, carrier ring .. .. .	IX.
worm, carrier ring .. .. .	IX.
Lever, extractor .. .. .	IX.
Wrenches—	
Breech mechanism { A .. .. .	IX.
B .. .. .	X and XV.
H .. .. .	X and XV.
Firing " { *K.. .. .	IX.
Nut vent .. .. .	IX.
Rimers, vent, axial—	
Long .. .. .	For guns using cordite vent primers.
Short .. .. .	IX, X and XV.
Wrench, stud and screw, No. 1 .. .. .	IX.

\* Also nut vent for Marks X and XV.

## EXTRACTOR, TUBE, SPECIAL, BOX, SLIDE, "A" (MARK I).

STEEL; B.L., 12-INCH, MARK IX; 9.2-INCH, MARKS X AND XV; 6-INCH MARKS VII TO VIII, AND B.L.C 5-INCH.

(Plate VIII.)

This instrument generally consists of a sheath or case (*a*) containing an actuating screw (*b*), which screws into the handle (*c*), and two extracting clips (*d*), which pivot on an axis pin (*e*) on the end of the screw (*b*); it is for use with guns having the "box slide, A" when the tube is so tightly jammed in the vent that the extractor in the box slide fails to remove it.

The sheath is suitably shaped at the clip end to admit of its being inserted in the "box slide, A," by being made square in section to prevent turning, and in having a flange (*f*) on two sides to bear on the sides of the box slide.

The revolving cross-handle (*c*) is attached to the sheath by two rivets (*g*); it actuates the screw (*b*), moving it in or out, according to the direction the handle is turned, the joint head of the screw and clips being made square in section to prevent their turning in the sheath. The outer ends of the clips fit into corresponding recesses in the box slide; by turning the handle a guide pin (*h*) (between the clips) causes them to diverge on passing out of the sheath and over the "box slide, A" extractor. On turning the handle in the opposite direction the clips will hook on the jaws of the "box slide, A" extractor, which, with the tube, will be forced out so that the tube may be removed by hand.

## ORDNANCE, B.L., LEVER EXTRACTOR.

This consists of a steel rod, about 9 inches in length, having too pieces at either end, which may be inserted in the loop of the extractor to which the lanyard is attached, the sides of the lock frame affording a fulcrum. It is intended for prising up the extractor of the lock in the event of it failing to withdraw the tube when the lanyard is pulled, and is only used with guns whose locks are provided with hinged extractors.

## GAUGE, STRIKER, ECCENTRICITY.

(For Inspecting Ordnance Officers.)

This gauge is of brass, with a removable copper plug, for testing eccentricity of striker in guns using P vent-sealing tubes. The gauge is similar in contour and external dimension to the "Tubes, vent sealing, electric, wireless" (page 84). A recess is formed in the outer end of the gauge for the reception of a copper plug. Across the outer end of the gauge are engraved cross-lines at right angles, one of the lines being marked with the maker's initials or trade mark.

*Method of Using the Gauge.*

Open the breech and insert the gauge in the tube chamber of the vent, care being taken to note the position of the maker's initials or trade mark on the outer end of the gauge. The breech will then be closed, the striker of the gun lock cocked, and released by pulling the trigger, when the indent of the point of the striker in the copper plug of the gauge will denote the amount and direction of eccentricity of the striker.

## GAUGE, STRIKER, PROTRUSION NO. 3.

The gauge is made of flat steel plate, and is for gauging the protrusion of the upper contact punch, or firing pin of the needle or striker in electric or percussion locks, for B.L. and B.L.C. guns, and the needle or striker in 1-inch Elswick "A" and "B," and 1-inch Morris B.L. aiming rifles. It has separate recesses for maximum and minimum gauging, and the depths of the recesses are as follows:—

Maximum	..	..	..	·09 inch.
Minimum	..	..	..	·07 inch.

*Instructions for Use of Gauge.**Gun Locks.*

Remove the lock from the gun and force the upper contact, needle, or striker through the firing hole as far as it will go. The gauge will then be applied to the front face of the lock.

*Aiming Rifles.*

1-inch Elswick "A."—Remove the breech block and push the striker forward as far as it will go. The gauge will then be applied to the front face of the breech block.



1-inch Elswick "B."—Open the breech and swing the breech screw and carrier into the loading position; release the retaining catch of the breech screw by hand; turn the breech screw into the locked position, and fold down the cam lever. The gauge will then be applied to the front face of the breech screw. (In the case of the Mark II rifle, the striker must be in the uncocked position.)

1-inch Morris B.L.—Open the breech of the gun, and place the electric or percussion needles, respectively, in position in the axial vent, and in the case of the percussion needle, force the needle through the dummy tube as far as it will go. The gauge will then be applied to the front end of the axial vent.

### SIDE ARMS, &c.

Description.	L.S. Marks of Guns for which used.
Brush, piassaba, bore, B.L. 9.2-inch, Mark II ..	IX, X and XV.
Brush, rammer, and sponge, B.L. 9.2-inch chamber:	
Land, No. 1 (Mark I) .. .. .	{ X and XV, and IX on Mark IV mounting.
Land, No. 2 (Mark I) .. .. .	IX on Mark III mounting.
Extractor, cartridge, B.L. 10-inch to 7.5-inch, Mark I.	IX to XV.
Extractors, (drill shell { No. 2 .. .. .	{ IX to XV, except IX on Mark III carriage.
(see also page 75) { No. 3 .. .. .	{ IX on Mark III carriage.
Lanyards, friction tube, garrison, No. 3 .. ..	IX to XV.
Staves { end, No. 8, Mark II .. .. .	{ All marks for lengthening brush stave.
{ intermediate, B.L., 9.2-inch .. ..	{ IX to XV.

*Brush, piassaba.*—The brush is used for cleaning the bore of the gun, in conjunction with a sponge cloth or piece of canvas tied on the head.

The head is of elm, having piassaba tufts secured into it by pitch or marine glue.

The stave is of ash, and is secured in the head by a copper rivet. It is fitted with a metal socket-joint, which consists of a metal plug fixed to the stave end, and a metal cylinder fixed to the brush stave; the plug is inserted in the cylinder, and secured in position by a thumb screw fitted to the cylinder. Total length, with stave, 28 feet 2½ inches.

*Brush, rammer, and sponge.*—The head which forms the rammer and sponge is made of elm, which is protected in front by a brass ring secured by brass screws; the part in front of the brush is covered with fleecy hosiery, which is secured by copper tacks and the brass ring. The brush portion is made of beech or birch in two parts, one part forming the brush and the other a packing ring. The tufts of bristles are secured in position by brass wire which is housed and secured in suitable grooves; the brush is retained in position on the head against a shoulder by an undercut, and by an angle copper ring and screws. The stave, which is of ash, is secured in the head by a copper rivet. A brass boss head screw is inserted in the stave 37 inches

from the front face of the rammer to denote when the projectile is rammed home. The length of the stave for the Mark IX gun on the Mark III mounting is 18 feet 6 inches (over all), and that for the Marks X and X<sup>v</sup> guns, and the Mark IX on the Mark IV mounting is 15 feet 6 inches (over all).

*Extractors.*—The cartridge extractor is a copper hook, which is secured in a wood stave. The total length is 6 feet. For drill shell extractors, see page 75.

*Lanyards, friction tube, garrison, No. 3.*, is of white line, tarred, with toggle and loop, and is used with the 9.2 inch guns on barbette carriages. Length 8 feet 8 inches.

*Staves.*—The end stave, No. 8, Mark II, for the piassaba brush (Mark II) is of ash, fitted with a metal plug to suit the socket-joint on the brush stave. The length is 16 feet.

The intermediate stave is for lengthening the piassaba brush stave. It is of ash, and is fitted at one end with a metal plug, and at the other with a metal cylinder to suit the brush stave and end stave. The length is 11 feet 6 inches.

---

## CARE AND PRESERVATION OF ORDNANCE AND THEIR FITTINGS, AND AIMING RIFLES.

See "*Regulations for Magazines, and the Preservation of Artillery Matériel.*"

---

### RIFLE, AIMING, 1-INCH, ELSWICK "B." (MARK I).

(Plate IX).

This apparatus, which is arranged for electric firing only, contains its own firing mechanism (the breech mechanism of the gun is not used with it), and is for use in the Marks IX to X<sup>v</sup> guns.

A complete set consists of the following parts:—

Rifle, aiming, 1-inch, Elswick, "B," B.L., 9.2 inch.

Marks VIII and IX guns (Mark I).

X and X<sup>v</sup> " ( " )

Barrel, 1-inch .. .. Steel.

Carrier .. .. Steel, with hinge pin, and keep pin; cover plate with fixing screws; and breech screw retaining catch with spiral spring.

Discs, adjusting barrel:— Steel.

.01 inch thick.

.005 inch thick.

Elbow piece .. .. Gunmetal.

(9389)

## Frames adjusting—

Front, B.L., 9.2 inch,		
Marks VIII and IX guns	}	Aluminium with gun-metal bush, three fixing screws, and set screw.
Marks X and X <sup>v</sup> guns		
Rear, B.L., 9.2 inch,		
Marks VIII and IX guns (Marks I and II)†	}	Steel.
Marks X and X <sup>v</sup> guns (Marks I and II)†		
Ring breech .. ..	..	Steel, with retaining catch in two parts, with keep pin and spiral spring; extractor with axis-pin, and keep pin.
Screw breech.. ..	..	Steel, with cam lever, hinge pin, and keep pin, case, and set screw.
Sleeve, withdrawing striker.. Steel.		
Striker .. ..	..	Steel, consisting of needle in two parts with keep screw, firing pin, and nut; insulating bush; two washers; sheath with nut; and main spring.

## Implements used.

Rifle, aiming, 1-inch, Elswick, "B."	
Extractor, cartridge	} Steel.
hand ..	
Tommy ..	.. Steel.
Wrenches:—	Steel.
"A" ..	.. For breech screw case, and small screws.
"B" ..	.. For adjusting frames and all nuts.
Wrench, rear frame 1-inch,	} Steel; for use with rear frames
Elswick "B" aiming rifle, Mark I ..	
	having continuous thread without handles only.
Rifle, aiming, 1-inch—	
Brush, cleaning ..	.. Without rod.
Rod, cleaning ..	.. Wood.

The 1-inch barrel is chambered and rifled on the Henry principle. It is prepared on the exterior at the rear, with interrupted thrust collars for the reception of the breech ring; the latter, which is prepared for the reception of the breech screw, is secured in position on the barrel by means of a spring catch, and is provided with lugs for the attachment of the breech mechanism of the aiming rifle. It is also fitted with a safety stop to prevent the breech screw from being closed until the breech ring has been locked in position

† Mark II frames have a continuous thread for screwing into the breech opening of the gun, they are of a lightened pattern, and are without handles.

on the barrel. An extractor, which engages with the head of the cartridge in the rifle, is pivoted in the breech ring in such a manner, that when the breech is opened and the carrier swung into the loading position, the cartridge is automatically released.

The breech is closed by a parallel screw having two interruptions corresponding with the interior of the rear portion of the breech ring and is supported, when withdrawn, by a carrier hinged to the breech ring. The screw is attached to the carrier by screw threads on the rear end, which engage with corresponding screw threads on the carrier, and is worked by means of a cam lever.

Fitted to the outer face of the breech screw is a case enclosing a main spring through the centre of which the striker passes. The striker is provided with an insulated needle, one end of which projects through the firing hole of the breech screw, and makes contact with the primer of the cartridge. The outer end of the needle is prepared for the reception of the contact on the electric cable from the firing battery, and is secured by nuts in the same way as is shown for the needle of the "E" lock.

An elbow piece is provided for the attachment of the cable; the outer end of this elbow piece, in present manufacture, has a groove for the reception of a projection on the cable connection for naval service.

To prevent the rifle being fired before the screw is locked, and the cam lever lowered, a withdrawing sleeve is fitted over a portion of the spring case, and attached to the rear end of the striker. A projection on one side of the sleeve engages with the cam portion of the lever in such a manner, that the first movement of the lever in opening the breech, automatically withdraws the striker within the face of the breech screw. The striker is automatically released when the screw is turned into the locked position, and the cam lever folded forward.

Steel discs are provided for adjusting the 1-inch barrel, and rear adjusting frame, when necessary.

#### *Method of Fitting and Using the Apparatus.*

The front adjusting frame is screwed over the barrel and secured by means of the set screw.

The barrel with frame and cylinder should then be placed in the breech opening of the gun, the part of the frame marked "TOP" being uppermost, the coned portion of the frame fitting the obturator seating of the gun. The rear adjusting frame is then placed over the rear end of the barrel, pushed into the breech opening as far as it will go, and turned so as to engage with the screw threads of the breech opening. The frame should be jammed tightly into position in the breech of the gun by means of the tommy, applied in one of the holes in the frame, and used as a lever. When correctly assembled the hole for the tommy should be to the left of up for the Mark IX gun, and to the right of up for the Marks X and X<sup>v</sup> guns.

In the event of the rear adjusting frame screwing beyond the position mentioned above, thin steel discs are provided, to be inserted over the rear end of the barrel as may be necessary, the frame being temporarily removed for this purpose.

The breech ring with carrier and breech screw in the open position, will then be placed over the rear end of the barrel, and revolved one fourth of a turn, in such a direction as will admit of

the retaining catch in the breech ring engaging with the recess in the barrel for its reception. Indicator lines are engraved on the breech ring and the rear adjusting frame, with instructions to facilitate assembling.

Care must be taken when removing the breech ring from the barrel to see that the breech screw and carrier of the rifle are always in the open position, and the extractor clear of the recess for its reception in the barrel.

Elevation is obtained by means of the gun or carriage sights, and any error in line can be corrected by using the deflection scale.

#### *Care and Preservation.*

All actions and parts of the rifle should be kept perfectly clean and oiled, so as to keep them in good working order and prevent rust. No cutting material, such as emery cloth, is to be used for cleaning.

#### *Ammunition used.*

Cartridge, aiming rifle, 1-inch, electric. For description, see page 71.

---

### CARRIAGE, GARRISON, BARBETTE, B.L., 9.2 INCH, MARK III.

(Plates X to XIII.)

This mounting is constructed to fire "en barbette" over a  $6\frac{1}{2}$  feet parapet. It allows a recoil of  $3\frac{1}{4}$  feet, and generally consists of carriage and slide with hydraulic buffers, sighting platforms, gears elevating, traversing, elevation indicator, and loading; roller ring; electric firing gear, pedestal, holdfast, racer, and traversing arc.

To mount the gun, &c., see page 51. Weights, &c., see p. 23.

#### *Carriage.*

The carriage consists of two cast-steel brackets (a), each having an opening for the reception of an hydraulic buffer. The brackets are grooved on the underside, and lined with manganese bronze where they bear against the slide. Clips are bolted to each side of the recess to engage with the upper flanges of the slide when the carriage is mounted. Trunnion bearings are formed in the upper sides of the brackets, in which the gun is secured by sliding metal capsquares, with keys. A bracket (b) is formed on each side under the trunnion bearings, to receive the nuts in which work the adjusting screws (c) of the ball bearings.

*Ball Bearings.*—These are intended to decrease the friction in elevating; they are fitted on the outside of each trunnion and carriage bracket. A false trunnion is screwed into the end of each trunnion of the gun, part of the false trunnion is octagonal-shaped to take the ball bearings, which consist of an inner and outer ring, fitted vertically over each other, each having a groove, so that when in position they form a path for the hardened steel balls; the ball bearing surfaces of these rings are thin hard steel rings let into the main rings; the inner ring fits over the octagon of the false trunnion,

# CARRIAGES.

Description.	Elevation in degrees.	Depres- sion in degrees.	Height of axis of trunnions above the racer in firing position.	Weight.		Diameter of trucks.		Radius of trucks.	
				Carriage.*	Slide.	Front.	Rear.	Front.	Rear.
			ft. ins.	tons. cwt.				ft. ins.	ft. ins.
Carriage, garrison, B.L., 9·2-inch—									
Barbette { Mark III .. ..	15	10	5 6·5	19 8	..	} Roller ring			
„ IV .. ..	15	20	5 11·5	26 3	..		4 4	4 4	
„ V .. ..	15	10	6 11·4	74 17½	..				

\* Weight of carriage on racer.

NOTE.—For *Special Implements* used with the above mountings, see Equipment Regulations.

and to prevent the bearings falling off it, a screw passes through a lug on the outer rings and into the carriage brackets. The bearings are adjusted by a vertical screw and nut, supported in the bracket (b); stout disc springs are placed on the screw, which then fit into a socket formed on the outer ring of the bearings. When the gun is elevated or depressed the inner ring and balls revolve together. When the gun is fired the disc springs are compressed, and the gun trunnions take a bearing in the trunnion holes, after which the springs expand, when the weight of the gun falls on the ball bearings.

*To Adjust the Bearings.*—Turn the adjusting screw in the required direction, and at the same time move the elevating gear by the hand-wheels until the gear works easily, then secure by the set screws.

### *Hydraulic Buffers.*

The buffers are in tension and designed to give an approximately constant pressure during recoil.

The cylinders are of steel, and placed in the openings in the carriage brackets from the rear, secured by a projection on the rear of each cylinder fitting into a groove in the opening, and a metal ring screwed on the front of the cylinders has a bearing against the carriage bracket opening. A metal stuffing box is secured into the front of the cylinder; a leather packing is placed in the stuffing box, and is kept in position by an inner packing gland, the latter is recessed to take a metal ring and cotton packing, screwed up by an outer metal gland. Each cylinder has a metal valve key or equalising strip fitted along the inside to fit the port of the piston; there is a filling hole on top near the rear, which is closed by a screw plug, and in front of this hole on the inside of the cylinder is a small groove which admits of any air which may have accumulated in the cylinder to escape over the piston; a draw-off valve is provided on the outside near the front, which is closed by a screw plug; and the cylinders are connected by a steel pipe (having a metal nozzle and coupling at each end) near the front, so that each may have an equal quantity of fluid.

The piston and rod are of steel, a manganese bronze ring is fitted round the piston to prevent scoring; a port for the valve key and passage of the oil is cut through the piston. A hole is bored in the rear end of the piston rod for the controlling ram. The front ends of the piston rods are connected by nuts to cast-steel brackets bolted on the front of each girder of the slide.

The rear of the buffer is closed by a metal cap screwed into it, and the controlling ram with adjustable plug is bolted in the cap. This controlling ram is of manganese bronze; it is hollow, and a small hole is bored through it near the rear end for the liquid to escape as the carriage runs up; the size of the central hole in the ram can be regulated by a small screw valve fitted to the end of the ram.

For contents of buffers, see page 51.

*Action.*—Both buffers are filled with oil, and on recoil the cylinders are drawn off the piston rods, the oil passing from front to rear of the piston, through the port; the equalising strip in the cylinder fits into the port of the piston, and so gives a uniform recoil. The slide has sufficient slope to enable the carriage to run up after recoil, the controlling ram preventing it running up too violently.

*NOTE.*—For running back at drill, &c., a pump is used; for description, see page 56.



*Elevating Gear.*

The elevating gear is fitted on the left side. The arc is secured to the elevating band on the gun, and gears with an arc pinion on a shaft which passes through the bracket of the carriage; this shaft has a worm wheel on its outer end, driven by a vertical worm shaft, having a bevel pinion on its lower end, gearing with another bevel pinion (the shaft and pinions are supported by a bracket fixed to the carriage) sliding on a longitudinal shaft, revolved by having a feather fitting into a featherway on the shaft. The longitudinal shaft is supported, in front, rear, and centre, on the side of the slide; and it is actuated by further wheels and shafts and hand wheel (Z) in front, and (Z') on the sighting platform, as required, the former being quick motion gear and the latter slow.

*Slide.*

The slide consists of two built up girder sides (*d*), formed of plates and angle steel riveted together, connected by three transoms and a centre bottom plate, and also by two box-shaped transoms (*e*), one under the front of the slide, and the other under the rear, and these are connected by two semi-circular pieces of angle steel, one each side. The slide is now strengthened by means of three steel stays at each side.

The upper roller path (*f*) in two segments is fixed to the under side of the box-transoms. A cast-steel bracket (*g*) is bolted to the front of each girder, and has a lug formed on the upper side for the attachment of the piston rods of the hydraulic buffers. The slide is fitted with part of the elevating gear; traversing gear; holding-down clips; sighting gear; loading gear; two laying platforms, with ladders; and a shield. The slide has a slope of 9 degrees.

*Traversing Gear.*

The slide is supported and traversed on a live-roller ring, which consists of two concentric steel rings, connected by collar rivets, and furnished with metal bushed holes for the axles, the latter being secured in the rings; the roller ring carries 16 "Rollers, carriage, No. 18" (*h*) of steel, metal bushed, flanged on both sides, and coned to suit the pivot. The slide is prevented from lifting by a holding-down clip casing (*i*), front and rear, which hook under a clip ring formed on the racer. The traversing gear can be worked by three hand wheels, two on the sighting platform in rear, and one on the left side in front; the front and rear motions are used separately, as required, the front gear being quick motion and the rear slow.

The gear consists of a train of wheels and shafts, motion being given to a vertical shaft at the front of the slide, on which is a pinion gearing with a rack round the outer edge of the racer.

*Sighting Gear.*

*Automatic Sights (Plate XIII).*—This gear is on the left side of the mounting, and is supported on the side of the carriage by "Bracket, sliding, sighting gear" (A), and on the slide by "Bracket, supporting sight, left" (B). The frame (C) carrying the sights is elevated or depressed by the action of the cam roller upon the cam (K) through a system of crank gear, made up of the cam bracket (D), cam roller lever (E), link for cam roller lever (F), square shaft (G), square shaft lever (H), front connecting rod (I), and trunnion



stud lever (J); the latter is fixed to the gun trunnion, and so actuates the gear. The roller is kept to its work by the spiral spring and spindle (L); the cam is also kept up to the roller by the retaining clip (M), which is fixed to the frame, and whose bent point clips the flange of the cam. One end of the cam is attached to its bracket and adjusted by an eccentric lever (N) in connection with a graduated arc (O), the other end of the cam is attached to the bracket by a screw working in an adjusting nut (P), whose frame also carries a packing piece, which can be reduced to give final adjustment. There is a separate cam for the full and  $\frac{3}{4}$  charges, and these cams are substituted by one cut to the range limit of the 1-inch aiming rifle when required, so as to afford increased practice in laying with these sights.

An error of day adjustment drum (Q), having a scale of yards "over" and yards "short," with reader, is fixed over the sight frame by means of a stirrup attached to the cam roller lever.

A steel pillar is fitted into the front end of the frame; it has a feather to fit a featherway in the frame to prevent it turning, and it is secured in the frame by a clamping screw; the top of the pillar is recessed to take a foresight, which is the same as for the Mark IV mounting, page 35.

The rear end of the frame is fitted similarly to the front end with a steel pillar, with cross-head having a sliding leaf with reader fitted on its rear face, traversed by a brass screw with milled heads; a scale plate graduated to 2 degrees left and right is fitted on the rear face of the cross-head.

*Bar, Testing, Sighting Gear, Automatic and Rocking Bar.*—The bar, which is of cast iron, is for use in testing, by means of the Service Clinometer, the accuracy of the telescope holders on the sight bars of automatic, reeking bar, and combined automatic and rocking-bar sights of B.L. and Q.F. carriages. It is formed at each end to fit the telescope holders, the intermediate portion having a plane for the clinometer. An arrow-head is engraved on the rear end which will be set to correspond with a similar arrow head on the rear telescope holder.

In future when testing the angle between the gun and the sight, the clinometer readings will be taken from the bar (fixed to the holders) instead of from the plane formed on the rocking bar.

A telescope sight (described at page 37), is also used with this gear; to use it the before-mentioned front and rear pillars are removed from the frame, the rear one being substituted by a pillar supporting telescope. This pillar has a cross-head which admits of a horizontal movement of the carrier giving deflection in a similar way to that of the auto-sight of Mark V barbette carriage, page 45.

An adjustable shoulder piece is now approved for use with this sight.

In the adjustment of auto-sights the last motion of the elevating gear must be depression, except for any particular mounting, with which it is ordered that the last motion must be elevation, and moreover the gun should be balanced as if loaded.

*Rocking Bar Sights.*—This gear is fitted on the right side of the carriage, and consists principally of a sight frame, which is actuated by a sight frame lever, a connecting rod, and a system of crank gears similar to that for the automatic sights. The front end of the sight frame is fitted with a fore sight, socket and pillar similar to that on the auto-sight. The rear end is fitted with a toothed arc, which is bored to receive the cross head of the hind sight. The cross head is

furnished with a notched deflection nut, traversing screw, and scale plate with pointer, and is graduated for 2 degrees deflection right and left. The words "right" and "left" and directing arrows are also engraved to clearly indicate the direction. The sight frame lever is pivoted at one end to the same hinge stud as the sight frame; the other end is provided with a worm and worm wheel with pinion, which engages with the arc on the sight frame, and with a drum for yard scale rings marked as follows:—

Charge.	M. V.	Range.
Full Cordite composite .. ..	2,643 f.s.	14,000 yards.
$\frac{3}{4}$ " " " " " " ..	2,196 "	12,000 "
$\frac{1}{2}$ " " " " " " ..	1,632 "	8,000 "
Full cordite .. ..	2,601 "	13,800 "
$\frac{3}{4}$ " " " " " " ..	2,127 "	11,700 "
1" aiming rifle .. ..	1,100 "	2,500 "

When greater accuracy is required, the cross head of the hind sight may be removed, and a pillar with a carrier for a sighting telescope inserted in its place.

For description of telescope *see* page 57.

#### *Elevation Indicator Gear.*

This gear is attached to the left side of the mounting, convenient to the front elevating hand wheel. A metal "arc segment, upper," is fitted on the front end of the automatic sighting shaft, secured by a collar and nut; it has teeth to gear with a steel "arc segment, lower," which works on a pin supported in bearings, in the front bracket of the gear; a steel pointer is attached to the latter sector, and works along a graduated plate fixed to the top of the bracket. A strong spiral spring is wound round the axis pin of the steel sector, one end being secured to the pin, the other to a stud on the sector; its use is to prevent back lash.

In latest manufacture the range graduations are in separate scales for full and three-quarter charges, and an adjustable pointer is provided (*see* page 43, Mark V carriage).

#### *Loading Gear.*

A forked lifting arm (*j*) is pivoted inside the sides of the slide at the rear, and has at its lower end a steel carrier (*k*) with metal loading tray; the latter is free to slide on three rollers in the carrier, so that it can be pushed forward into the gun to protect the threads of the breech screw, a spring which engages a slot in the tray prevents it being pushed out of the carrier, the spring is disengaged, when required, by means of a small cam lever. A steel arc (*l*) is attached to the right arm of the fork into which gears a pinion on the inner end of a spindle, supported in bearings in a bracket, bolted to the right side of the slide; on the outer end of this spindle there is a spur wheel worked by a pinion and winch handle. A notch is cut in the inner side of the arc to

take a pawl to hold the arm in the loading position, the pawl is fitted with a handle. To assist in raising the projectile, a cast-iron counterweight (*m*) is suspended by two steel cords, which pass over pulleys on the rear holding-down clip, and the upper end of each cord is attached to the upper arms of the fork. When the bearer with tray is vertical or in a position to receive the projectile, the cords pass under the pivots of the lifting arm, and have a tendency to retain the arm down; but as soon as the gear is worked sufficiently to bring the cords above the pivots, the counterweight drops and helps in raising the weight. The gun is loaded at 15 degrees elevation; a stop is fitted to the side of the carriage to prevent the arm, raising projectiles, fouling the cross-shaft of the traversing gear; a bracket with wood block fitted to the arm forms a stop for the breech in that position; a stop (*n*) is also fitted to the front of the arm to bring the carrier vertical to receive the projectile. Foot rests are fitted to each side of the arm, so that a man can be raised by the gear to place a tube in the vent.

#### *Shield.*

The shield is of steel, with an opening in the front to allow 15 degrees elevation and 10 degrees depression being given to the gun; it has also two smaller openings in the roof for sighting purposes. The shield rests upon, and is attached to stays, the latter being bolted to the slide.

#### *Gear firing, Electric.*

The gear for this mounting will be somewhat similar to that for the Mark V carriage.

The cables will bear the following letters and numbers.

Gear firing electric—

Cables:—

	Length.	
	ft. in.	
A, No. 10	22 6	.. White; from gun to sliding contact.
B, No. 10	7 0	.. Purple; from sliding contact to safety plug box.
C, No. 7	15 0	.. Red; from right hand pistol grip connector to safety plug box.
D, No. 6	14 0	.. Yellow; from right hand pistol grip connector to battery.
E, No. 7	10 0	.. Black; from left hand pistol grip connector to safety plug box.
H, No. 10	9 0	.. Uncoloured; from left hand pistol grip connector to battery.

The following traversing arc, holdfast, pedestal, racer, blast shields, and cover are used with this carriage:—

#### ARC TRAVERSING, No. 34.

Mark I: This arc is of brass, made in two ring sections, each being in lengths; the degree figures are engraved upon the upper

section, and the division and sub-divisions on the lower one. It is secured round the outer face of racer below the clip ring; the angle of traverse is indicated by a pointer fixed to the slide.

Radius 5 feet 1'442 inches.

Weight 2 qrs. 4 lbs.

#### HOLDFAST, CARRIAGE PEDESTAL, No. 4A.

Mark I holdfast is of steel and consists of 13 anchoring plates, and 52 holding-down bolts which are 9 feet 11 inches long, each having a cotter, the bolts are nutted to the bottom flange of the pedestal and embedded with the anchoring plates in concrete.

Weight 4 tons 10 cwt.

#### PEDESTAL, CARRIAGE, No. 4.

Mark I pedestal consists of two semicircular castings (O), Plate X, with two joint plates and bolts, secured together when in position. It is formed with a flange at the bottom, which is bored for the holding-down bolts of the holdfast, while the top is prepared for the racer.

Weight 17 tons 17 cwt. 3 qrs.

#### RACER, CARRIAGE, GARRISON, BARBETTE, MARK III, B.L., 9'2-INCH.

Mark I racer is of steel, bolted on the top of the pedestal by bolts on each side of racer, 30 on the outside and 16 on the inside of it. A clip ring or flange is formed on the outer face, to engage the holding-down clips of the carriage; and a traversing rack is bolted on above the clip flange.

Weight 3 tons 0 cwt. 2 qrs. (complete).

#### BLAST SHIELDS.

In cases where it is found desirable to protect the gun layer from the effects of the blast of adjacent gun or guns, shields will be fitted to the carriage as follows—

The shields will be made of sheet iron, each shield being secured in position by means of a stay to the platform, and by three wrought iron straps and  $\frac{3}{8}$  inch bolts to the handrail in suitable places. The shields will be made locally, as may be found necessary.

#### COVER, CARRIAGE, B.L., 9'2-INCH, MARK III, BARBETTE (MARK I).

This is of waterproofed canvas, formed to protect the working parts of the carriage. It is secured in position by straps and buckling pieces, which are stitched on.

CARRIAGE, GARRISON, BARBETTE, B.L., 9.2-INCH,  
MARK IV (FOR MARK IX GUN).

(Plates XIV to XVIII.)

The mounting is constructed to fire "en barbette" from an elevated emplacement. The gun recoils axially about 3 feet 6 inches, extreme 3 feet 9 inches, in a steel cradle (A), which is fitted with an hydraulic buffer to control the recoil, and an air chamber to return the gun to the firing position; the cradle is mounted on a steel carriage (B), which is revolved on a live roller ring upon an iron pedestal (C).

For weights, &c., see table, page 23.

To mount the carriage, gun, &c., see page 52.

*Connecting Band and Sliding Blocks.*

(Plate XVIII.)

The gun trunnions fit into a pair of steel "blocks, sliding," which are H section, connected in front by "band, connecting, gun and buffer." This band is secured to the gun in front of the trunnions, and to the sliding blocks by a rectangular projection on either side of the band, fitting into a corresponding recess in the blocks; the band and blocks are fitted to one another by eight steel screws on either side. The lower part of the band has a circular hole which passes over, and is fixed to the buffer cylinder: thus the gun, band, sliding blocks, and buffer cylinder recoil together.

A combined grease box and brush has been fitted to each of the sliding blocks for use in cleaning and efficiently lubricating the sliding surfaces of the cradle in which the blocks slide. The brush is attached to the rear of the grease box by means of an angle plate, on which it can be adjusted to give the necessary pressure for cleaning the sliding surfaces. The brush should be frequently cleaned to remove grit, &c. The lubricant used is a mixture of blacklead and tallow, in the proportion of 14 lbs tallow to 1 lb. of blacklead.

*Cradle.*

(Plate XVIII.)

The cradle consists of two guides secured at each end by a transom bracket, the front bracket carries the buffer piston rod and the rear the air chamber. It is provided with trunnions, having ball bearings as for the Mark III mounting, the adjusting screws and spring discs are on the carriage; and an elevating arc is fixed on each side of the cradle. Covers for the protection of the trunnion bearings will be made locally as required.

*Hydraulic Buffer, Air Chamber, &c.*

(Plate XVIII.)

The principal parts of these are:—Cylinder (b), piston (c), piston rod (d), with controlling ram (l), air chamber (f), intensifier (g), and air pump (h). The cylinder, piston, and rod, are of steel; the air chamber, &c., of manganese bronze.

The buffer cylinder, which forms also the ram of the air chamber, is held at the front end by the gun band, and is prevented from turning by a steel feather, a steel securing collar screws on to the large gland in front of gun band, where it is held by a set screw; the cylinder is sheathed with metal to prevent scoring; the front of the cylinder is closed by a large manganese bronze gland screwed in, in which is placed an L leather secured by a metal stuffing box containing .75-inch square section hydraulic packing, which is compressed by a small inner gland of manganese bronze which screws into the stuffing box.

The escape of air from the air chamber is prevented by the use of liquid in the gland, this liquid being supplied from the intensifier to the gland at a slightly higher pressure per square inch than the air in the chamber. During recoil the entry of the ram compresses the air in the air chamber, and this air is used to restore the gun to the firing position. The return movement is controlled by a controlling plunger in the piston rod of the buffer, the resistance of which may be adjusted by a plug valve (*e*) on the axis of the rod. For charging the air chamber, an air pump is provided on the upper side of the chamber, having a copper connecting pipe (*i*); there is an attachment in rear of the air chamber for a pressure gauge.

The intensifier is for supplying liquid to the gland by means of a copper pipe (*j*). It consists of a cylinder, on the lower side of the air chamber, in which works a piston, with piston rod passing through a stuffing box, formed in the front end of the cylinder; the rear end is in communication with the air chamber. The cylinder will require filling when the piston rod of the intensifier is seen projecting about 3 inches; it is provided with a filling hole. To fill the cylinder, remove the plug from filling hole, place a funnel in the hole, a special clamp is used for pushing back the piston rod, this clamp consists of two tie-rods, two cross-pieces, and a compressing screw with lever, and on screwing up the clamp the fluid will be drawn into the cylinder. See also care and preservation, page 51.

#### *Carriage.*

The carriage consists of two sides built up of steel plates, to which are riveted steel castings forming the trunnion bearings. The sides are braced together by transoms, and are fixed to the front and rear bolsters or box transoms; sections of upper roller path are secured to the bolsters. The capsquares are of forged steel, and each one is secured by six screws. The carriage rests on a live roller ring, similar to that for the Mark III mounting, *see* page 25, and fitted with 16 steel "Rollers, carriage, No. 18"; the ring revolves on a racer attached to the pedestal. Steel clips, front and rear, secure the carriage to the lower roller path. A sighting platform is attached to the right hand side of the carriage, from which also elevating and traversing the gun can be effected. A pointer is fitted to each side of the mounting, for use with the traversing arc, which is bedded in concrete surrounding the pedestal.

#### *Gear Firing Electric.*

This gear is arranged on the mounting, so that the gun can be fired from either side or from the position finder station; in the latter case a safety plug in a safety plug box is used.



The gear generally consists of two contact boxes, a pistol grip, safety plug box, two connectors pistol grip, connection cable to battery box, battery containing four electric Le Clanché cells with connecting wires, and six cables.

The *contact boxes* are of gun-metal, and are called "boxes, contact, sliding, Plug No. 3, and Plate No. 3." The plug is of gun-metal with cap, contact plug in two parts, spiral spring, and insulating bush. The plate is of gun-metal, with contact plate, insulating bush, and fixing screws, and they are fitted to suitable brackets. Contact is made when the gun is run up in the firing position.

The *pistol grip*, Mark III, is the latest approved pattern for this gear. The case is made of an alloy of aluminium, and is fitted with an insulated bronze contact needle, an indicator with cover and adjustable reflector, bronze contact lever, bronze trigger, and a system of contacts and springs. The needle end of the pistol grip fits into the connector at either side of the carriage, and is clamped by a screw. The indicator is intended to indicate that the electric current is present by a white disc appearing, by lightly pressing the contact lever (which is hinged in a slot in the pistol handle or grip). As this pattern of pistol grip is intended to be taken about to which ever side the gun is to be fired from, care should be taken not to jar or otherwise injure it by rough usage, and when not in use it should be replaced in its wooden box.

The *safety plug box* is fitted on the left side of the carriage, and is provided with terminals for the cable contacts and position finder.

The *connectors pistol grip* are made to receive the Mark III pistol grip and the electric cables, and are attached one on each side of the carriage. The connector consists principally of a socket, with jamming block and clamping screw to secure the pistol grip, and a gun-metal block with means for attaching the cables. A hinged cover plate on the socket protects the terminal clips within the socket when the pistol grip is withdrawn.

The *battery box and electric battery*. The box is secured to the carriage on the left side, and is constructed to contain four electric cells, Le Clanché, A, Mark III. It is of steel, with lid, handles, and bearing strips, the whole being galvanised throughout. Gun-metal fittings are riveted to the exterior for the attachment of the "connection cable to battery box." Electrical connection is made direct to the battery by means of copper strips, one of which is riveted to the afore-mentioned fittings, and the other to the box.

The box is lined with mahogany and fearnought, has felt pads to separate the cells, and indiarubber strips for them to rest on. It is closed and rendered watertight by means of a rubber-lined lid (with a mahogany packing piece), which is secured in position by two hinged screws, with fly-nuts, pivoted to the box, and engaging with suitable openings in the lid.

The *battery* consists of four electric cells, Le Clanché, A, Mark III. The cells are of ebouite, rectangular in shape, 8.75 inches by 5.55 inches by 2.7 inches, 6 block agglomerate; they are issued filled and sealed, and all that should be necessary to set them in action is to fill them three parts full with a saturated solution of sal-ammoniac in water. The cells are put in position in the box, with a felt pad between each one, and then connected up to the copper strips before-mentioned, and each cell in series, i.e., the positive pole of one cell to the negative pole of the next, and so on, by means of a wire and two mill-headed nuts for each terminal, and should be so arranged that the outside negative pole of the battery is connected to the box

by the copper strip, and the outside *positive* pole connected to the gunmetal fittings by the copper strip at the other side of the box.

For care and preservation of electric firing gear and cells, see pages 54-55.

The six *M I electric cables* are copper wire braided, with connecting nuts; each cable being of suitable length, and having a distinguishing colour, letter, and number, the two latter are engraved on the nut connection at the end of each cable, and are filled in with red wax.

The following are the particulars of the cables :—

Gear, electric firing—

	Length.			
	ft.	ins.		
A, No. 11	17	0	..	White; from gun to sliding contact.
B, No. 11	9	6	..	Purple; from sliding contact to safety plug box.
C, No. 8	19	0	..	Red; from right hand pistol grip connector to safety plug box.
D, No. 7	19	6	..	Yellow; from right hand pistol grip connector to battery.
E, No. 8	5	0	..	Black; from left hand pistol grip connector to safety plug box.
H, No. 11	5	8	..	Uncoloured; from left hand pistol grip connector to battery.

#### *Elevating Gear.*

An elevating arc is attached to each side of the cradle, and actuated by worm wheel gear, the worm wheel has a friction clip clutch, formed by a series of alternate steel and metal plates. The gear is so arranged that it can be worked by hand wheels, either from the sighting platform on the right or from either side of the mounting at the ground level, the former being slow motion gear, and the latter quick.

#### *Elevation Indicator Gear.*

This gear is on the left side of the mounting and consists of an arc segment; spur pinion; spindle, with collar and nuts; spiral spring; steel pointer; graduated range dial; and bracket for spur pinion.

The arc segment is pivoted on the hexagonal end of the false trunnion of the cradle trunnion, its lower end is furnished with teeth which gear with the spur pinion. The gunmetal spur pinion bracket is fixed to the carriage, its outer end being in the form of a disc, and recessed on the outer face to take the range dial of aluminium, these are secured to each other by screws, locally. The spindle for the spur pinion, working in its bracket, passes through the range dial and carries the pointer which is secured by collar and nuts. To keep the spur pinion up to its work, or to prevent back lash, a spiral spring is used; one end is passed over a stud on the pinion and the other end is attached to the spur pinion bracket by a screw.



Therefore, any movement of the gun in its cradle will actuate the pointer (by means of the segment and pinion), which will indicate the required elevation or depression on the dial connected to the carriage.

Covers for the protection of this gear will be made locally as required.

In latest manufacture the dial is graduated with separate scales for full and three-quarter charges, and an adjustable pointer is provided. See Mark V carriage, page 43.

#### *Traversing Gear.*

Traversing is effected by the traversing pinions on the carriage engaging with the rack secured to the racer casting; the front pinion is actuated by bevel and spur gear, and a cross shaft passing through the sides of the carriage, near the front, this shaft has a hand wheel on each end worked at the ground level; or by an inclined shaft on left side gearing with a bevel wheel on the cross shaft, and driven by a hand wheel from the sighting platform; this latter is the slow-motion gear of this section; there is a separate quick-motion gear at the rear, right side, the rack pinion of which is actuated by shafting, spur, bevel gear, and a hand wheel worked from the sighting platform. Each upper hand wheel of the gear is now fitted with a folding handle.

#### *Sighting Gears.*

*Rocking-bar sights.*—This gear, which is fitted to carry sighting telescopes, is attached on the left side and fitted on the top of the cradle by means of "Bracket, supporting rocking-bar sights, front and rear"; and consists of a steel sight bar pivoted to the front supporting bracket. The rear end of the sight bar is fitted to the rear supporting bracket, and furnished with a hind sight having a cross head, fitted with a deflection nut and reader, traversed by a brass screw, furnished with milled heads. A scale plate of crown metal is attached to the rear face of the cross head by two screws; it is graduated for two degrees right and left deflection, the deflection nut is of steel with a sighting notch .06 inch deep; a crown metal reader is attached to the rear face of the nut by two screws. Deflection is obtained by traversing the nut with reader till the point of the latter is over the required graduation on the scale plate. The lower portion of the sight consists of a sight arc, fitted on the rear face with a removable range strip graduated to 15 degrees; the muzzle face of the arc is furnished with a rack which engages with a pinion actuated by worm and hand wheels. Attached to the pinion spindle is an 8-inch drum, which is fitted for the reception of any one of the undermentioned yard scale rings.

Charge.	M. V.	Range.
Full Cordite Composite	2,643 f.s.	14,000 yards.
$\frac{3}{4}$ " "	2,196 "	12,000 "
Full " "	2,600 "	13,800 "
$\frac{3}{4}$ " "	2,127 "	11,700 "

There is also a suitable yard scale ring for use with the 1-inch aiming rifle. To facilitate reading the yard scale, a steel reader is attached to the bracket worm wheel. All scales and range strips are of aluminium.

The foresight is of steel, and consists of a holder, straight-edge sighting blade, acorn for fine laying, adapter with adjusting and fixing screw. The acorn fits into a recess in the holder where it is secured by a screw. The blade is fitted on the holder and secured by an arm which passes through a hole in the holder, upon which fit a spiral spring and collar with taper pin, the object of the spiral spring being to allow the blade to be pulled outwards and folded down when not required in a vertical position. The holder fits into the adapter, and is secured to it by a screw; the adapter is free to move in a recess in the rocking bar, and prevented from turning by a feather on it, which fits into a featherway in the recess; the adapter is moved from below by an adjusting screw, fitted into the rocking bar and clamped by a hexagon fixing screw, which passes through the adjusting nut into the adapter. The sight is in adjustment when screwed down home, and this should be regarded as the normal position of the foresight, correction being made only to suit the individual gun layer, should time permit of the gun being carefully laid on a distant target.

*Automatic sights.*—Plate XVII.—This gear is on the right side, and principally consists of a cam lever (A); cam (B); cam roller lever (C), with axle and roller (C<sup>1</sup>); crank shaft bracket (D); cam and cranked lever connecting rod (E); spring and spindle in case (F), with bracket (F<sup>1</sup>); bell cranked lever (G); pivot and cranked lever connecting link (H); sight bar (I), with foresight, telescope, and hindsight.

An adjustable shoulder piece is now provided for use with this sight.

The cam lever is fixed to the cradle trunnion, and with the cam moves with the gun, as the latter is elevated or depressed, the roller moving along the cam by means of the cam roller lever; the sight bar is moved also, but at a different speed to that of the gun, a spring and spindle keeping the cam roller up to its work in the cam.

The sight can be moved by elevating or depressing the gun, and the cam is so shaped that the angle between the axis of the gun and the line of sight is always equal to the proper angle of elevation for the range. From this, it will be seen that the cam must be cut to suit the height of the gun above the sea, and each cam will thus be special to the site for which it is made, and also for the full, and three-quarter charges, and these cams will be substituted by one cut to the range limit of the 1-inch aiming rifle, when required, so as to give increased practice in laying with these sights by using the rifle.

The sight bar is pivoted in the centre to the cam roller lever, and secured by a screw pivot.

The foresight on the sight bar is the same as that for the rocking-bar foresight, described above.

The rear end of the sight bar is fitted for the deflection nut of a cross head, fitted and clamped by a clamping screw to the rear end of the cam roller lever; the deflection nut is fitted to slide in the cross head, and is traversed by a brass screw with milled heads; a scale plate is fixed to the rear face of the cross head, and graduated to 2 degrees deflection left and right; a reader is fixed to the deflection nut, and slides over the scale plate. The sight bar being pivoted in the centre admits of deflection being given in the usual way.

The stem of the cross head is fitted with a milled head metal "Nut, adjusting, error of day," having a scale round it, graduated in yards "short" and yards "over"; by its means the relative positions of the sight bar and the cam roller lever can be altered to the extent necessary to compensate for any error observed in the shooting. A telescope is provided for laying on distant objects or where extreme accuracy is required. The telescope fits in two holders on the sight bar and is capable of being adjusted to suit different layers, the holders being provided with hinged caps to retain the telescope in position. For description see page 37.

*Bar, testing, sighting gear, automatic and rocking bar.*—The bar, which is of cast iron, is for use in testing, by means of the Service Clinometer, the accuracy of the telescope holders on the sight bars of automatic, rocking bar, and combined automatic and rocking-bar sights of B.L. and Q.F. carriages. It is formed at each end to fit the telescope holders, the intermediate portion having a plane for the clinometer. An arrow head is engraved on the rear end which will be set to correspond with a similar arrow head on the rear telescope holder.

In future when testing the angle between the gun and the sight, the clinometer readings will be taken from the bar (fixed to the holders) instead of from the plane formed on the rocking bar.

In the adjustment of auto-sights the last motion of the elevating gear must be depression, except for any particular mounting with which it is ordered that the last motion must be elevation, and, moreover, the gun should be balanced as if loaded.

Care and preservation, see page 52.

The following traversing arc, holdfast, pedestal, racer, telescope, and cover are used with this carriage:—

#### ARC, TRAVERSING, No. 33.

The arc is made of metal, in three sections, each one being in segment lengths; the centre section has the divisions and subdivisions graduated upon it, and the other two the degree figures, thus admitting of the degrees of traverse being read by either the right or left pointer attached to the carriage (the inner figures with left pointer, and the outer figures with right pointer).

The arc is secured by steel screws to cast-iron nuts, large nuts for the figures and small for the graduated division lengths, let into the emplacement.

Radius from centre of middle section of arc 5 feet 10 inches.

#### HOLDFAST, No. 4B.

This is of steel, and consists of 13 anchoring plates, and 52 holding-down bolts, which are 6 feet 7 inches long; the bolts are nutted to the bottom flange of the pedestal and embedded with the anchoring plates in concrete.

Weight 3 tons 13 cwt. 1 qr.

#### PEDESTAL, CARRIAGE, No. 4 (MARK I).

#### RACER, CARRIAGE, GARRISON, BARBETTE, MARK IV, B.L. 9·2-INCH (MARK I).

The pedestal is identical, and the racer is similar, to those of Mark III carriage, p. 29.

Weight of racer 3 tons 1 cwt. 3 qrs., complete.

## TELESCOPE, SIGHTING, No. 1.

*In wood case, for automatic and rocking-bar sights; garrison carriages.*

Mark I telescope is about 25-inches long over all; it has an object glass, and terrestrial eye-piece: the lenses are of such sizes as will obtain a large field of view with a low magnifying power; the magnification is about 3 diameters, and the field of view is about 10 degrees; a pointer is fixed in front of the eye lens. There are two gunmetal bearings externally about the centre, each  $3\frac{1}{2}$  inches long and  $2\frac{1}{4}$  inches diameter, which allow 3 inches of movement to suit the convenience of different gun layers. A long dew cap is fitted over the object glass end, and is provided with a loose metal cap.

The eyepiece with indiarubber shield, to protect the forehead of the gun layer from shock when firing, screws on to the main tube of the telescope, and is fitted with a broad 3-ring milled focussing nut.

Mark II differs from Mark I telescope in having improved focussing arrangements. The focussing is effected by turning the eyepiece portion of the tube, the amount of turning movement being read off on a scale numbered 0 to 7, so that individual observers may set their focus to the figure previously determined. The length is 24 inches.

Telescopes of this Mark are provided with a diamond-shaped pointer fixed in front of the erecting lens.

Weight about 6 lb. 10 ozs., Mark I.; 7 lbs., Mark II.

Full particulars as to care and use of the telescope are secured to the inside of the lid of the wood case in which the telescope is kept when not in use. Ordinary chamois leather is used for cleaning the object glass of the telescope.

## TELESCOPE, SIGHTING, No. 3.

*In wood case, for automatic and rocking-bar sights; garrison carriages.*

This is generally similar in construction to the No. 1, Mark II, but is of higher power, *i.e.*, magnification 10, field of view  $3\frac{1}{2}$  degrees, and a  $\wedge$ -shaped pointer.

COVER, CARRIAGE, B.L., 9.2-INCH, MARK IV, BARBETTE (MARK I).

This is similar to that for the Mark III carriage, page 29.

## LOADING ARRANGEMENTS FOR USE AT GIBRALTAR WITH THIS CARRIAGE.

The ammunition, carried by its trolley, is brought up by lift from the ammunition stores—two lifts are furnished so that there may be no interruption in the supply of ammunition. The lifts (with metal rails on top) form part of the circular railway, laid at a radius clear of that described by the breech of the gun, to enable the gun to be loaded at almost all degrees of traverse. Another line of rails, laid at a greater radius than the last mentioned, takes a loading platform which is moved round with the loading trolley.

*Loading trolley.*—This is an iron box with wood casing to take the two half-charges, side by side, in the direction of length of trolley; it is fitted with two axles and four railway trucks. On top a projectile metal carrier is pivoted, which can be turned through a half-

circle, and clamped by a clamping lever, in the loading and fore and aft positions, it carries a metal tray to take the projectile, the tray is free to slide on three rollers in the carrier, so that it can be pushed forward into the gun to protect the threads of the breech screw while loading, a spring on the carrier engages a slot in the tray, thus preventing it being pushed out of the carrier, the spring is disengaged by means of a small cam lever. A lever is hinged to the pivot bracket on the inner side of the trolley for attaching the trolley to the breech of the gun, the latter being elevated for this purpose.

*Loading platform.*—This is of iron, fitted underneath with four railway trucks on two bent axles to suit the different level of rails on the sloping ground, the inner ends of the axles have gunmetal rollers which fit under a bearing plate in the face of the emplacement to prevent the platform upsetting outwards; the inner corners are each fitted with a screw for clamping the platform to the work during loading; an iron handle is fixed near each end of the platform for use in moving it, and guard-irons are fixed on the outside.

#### CARRIAGE, GARRISON, BARBETTE, B.L. 9·2-INCH, MARK V.

(Plates XIX to XXVII.)

This mounting is constructed to fire *en barbette* from a pit emplacement, 28 feet in diameter and about  $8\frac{3}{4}$  feet deep, and generally consists of a cradle with elevating and sighting gears; carriage with shields, loading, traversing, and indicator gears; pedestal with holdfast, pivot plate, and live roller ring.

The gun recoils axially in its cradle about 3 feet 6 inches, extreme 3 feet 8 inches.

For elevation, depression, weights, &c., see table, p. 23.

To mount the carriage, gun, &c., see p. 52.

#### *Bands and Sliding Bars.*

The bands are front (A) and rear (B); the former is cast in three pieces and the latter in halves; they are bolted together after being placed in position on the gun. The front band is secured to the gun about the centre of gravity, and the rear band in its seating near the breech; the last named band is prevented from turning by a key on the gun. These bands have projections on their sides, where they join, upon which are fitted sliding bars (C); these bars are each 11 feet 11·8 inches long, each having an anti-friction metal bearing plate extending 5 feet from the front, the bars fit into corresponding sliding surfaces in the sides of the cradle.

There is a projection on the lower side of the front band which has a hole formed by the two lower castings for the cylinder of the hydraulic buffer, the castings are fixed together by screw bolts.

The gun, bands with sliding bars, and buffer cylinder recoil together.

#### *Cradle.*

This is of steel castings, and consists of two sides (D), 8 feet 10·7 inches long, prepared on the insides for the sliding bars attached to the gun bands, grooved to contain lubricating material, and connected at the ends by a front and a rear transom bracket. The front

bracket has a hole for the reception of the piston rod of the hydraulic buffer, and the rear bracket is cast to take the air chamber, bronze anti-friction strips being let in on its upper hollow for the gun.

*Ball bearings. Plate XXII.*—The cradle is provided with ball bearings in a manner somewhat similar to the Mark III barbette mounting, pages 22, 24. An anti-friction ball bearing is fitted on the outer end of each trunnion; each bearing consists of 24 hard steel balls, which work in a groove formed by two hard steel bevel rings secured by a metal adjusting nut screwed on to the trunnion, consequently these revolve with the cradle; over the balls is a steel band having on its inner circumference a hard steel bearing ring, which is let in and secured by a retaining steel ring and three screws on the inside face; there is a socket formed on the underside of the band for the supporting screw of ball bearing; this screw has a cylindrical head, to fit the socket just mentioned; below it is a hexagon shoulder to take a spanner, the lower part of the screw being threaded to screw into a corresponding hole in a projection on the carriage side; a pair of No. 46 spring discs is arranged on the cylindrical part of the screw. Movement of the cradle in its bearings is rendered easy by the adjustment of the supporting screws.

A steel elevating arc is bolted to the underside of each of the cradle sides, the arcs being connected and strengthened by a cross transom bar. Fitted to the front of the left arc is a metal arc for the elevation indicator gear.

The left trunnion is cast hollow and prepared for the elbow pipe of the hydraulic system, the hollow is continued along the side of the cradle to the rear, where it is connected to the recoil utilising cylinders of the hydraulic gear.

In future manufacture the face of the right-hand cradle trunnion will be engraved with one vertical and one horizontal line.

A clinometer plane is cut on the top of the cradle on the right side.

#### *Hydraulic Buffer and Air Chamber.*

##### *Plate XXI.*

The hydraulic buffer (E) is in tension, the cylinder forming the ram of the air chamber; the piston rod and air chamber are secured to the brackets of the cradle. The front band (A) takes the cylinder of the buffer, which is retained by a screw collar of steel screwed on to the front of the stuffing box, a steel feather let into the cylinder and band underneath prevents the cylinder turning in its housing. The rear bracket carries the air chamber, which is secured to it by two screws underneath and one on top. The piston rod is connected to the front bracket of the cradle by a screw collar in rear and a nut and keep pin in front.

The buffer admits of 3 feet 8 inches recoil, metal to metal, and will hold  $9\frac{1}{2}$  gallons of liquid.

The cylinder is of steel, and is 5 feet 11 inches long and 14.4 inches diameter, over all, and is sheathed with gunmetal, to prevent scoring the bearings of the air chamber, the sheath being 5 feet 1 inch long, and secured to the cylinder by small screws in rear; internally there is a manganese bronze valve key which fits into an undercut groove in the cylinder and is secured by a screw; the front end of the cylinder is prepared for the large or inner gland which is screwed in, and which contains an L-leather; the stuffing box for hydraulic packing screws into this inner gland, the packing being tightened up by a small or outer gland which screws into the stuffing



box; the rear end is prepared internally for the reception of the controlling plunger, externally it is cupped out so as to offer a large surface to the air in the chamber. It has a filling and emptying valve on the underside and an air plug on the top.

The *piston* with rod is of steel, 6 feet 8.6 inches long, over all, 6.2 inches diameter, bored out internally for the controlling plunger and manganese bronze adjusting valve tube. The piston is 10 inches diameter, and has two manganese bronze rings let into undercut annular grooves to prevent wearing the cylinder by scoring; there is also a port for the valve key of the cylinder. The piston rod is screw threaded in front for the connecting collar and nut respectively.

The *controlling plunger* is a steel rod 2 feet 10.8 inches long, over all, and 3.4 inches diameter, tapered at the point; it screws into the rear end of the cylinder. A flat is formed along the surface, terminating radially near the base, for the passage of fluid from the hole in the piston rod. It is now made so as to give a more uniform "run up" than formerly.

The *air chamber* (F) is a manganese bronze casting; it is 8 feet 4.5 inches long, 18 inches diameter outside and 15 inches inside, divided into two parts by a diaphragm, the rear part containing the tube (h), which has a valve at either end for charging the chamber. The front end of the chamber is closed by a gland containing hydraulic packing, secured by a metal flange. To prevent the escape of air over the gland, liquid is supplied to the gland by an intensifier, at a higher pressure per square inch than that of the air. A small port (i), admits air, also a small quantity of the 3 quarts of oil in the chamber, into the cylinder of the intensifier. There is an air escape valve on top of air chamber over the main gland, to allow air to escape from the gland when filling the intensifier by funnel.

For charging the air chamber an air pump is connected to one of the wing channels (j), while a pressure gauge is applied to the other channel, and by opening the valve (k), air will be admitted to the chamber up to an initial pressure of 200 lb. per square inch. A small air pump is attached to the carriage for maintaining the internal pressure in the air chamber.

The *intensifier* (G) is for supplying liquid to the gland, as before stated, and consists of a cylinder cast in the rear division of air chamber; it has an internal diameter of 4.6 inches, provided with a piston and rod, inner and outer glands, all of manganese bronze; the piston has a suction leather front and rear secured to it by thin plates and screws, and has a stroke of 10 inches. The cylinder will require refilling when the rear of the piston rod is about flush with the rear of the inner gland; filling is effected by applying a pump to the filling hole, marked "A<sup>1</sup>" on the plug (*see* care and preservation, page 54); oil will flow into the cylinder in rear of the piston, the pressure of which will be greater than the air and oil coming through the small port (i), from the air chamber; thus the oil will be forced through the pipe (l), on to the air chamber main gland. In the absence of a pump, a funnel and special clamp may be used, the latter for pushing in the piston rod; this clamp consists of two tie-rods, which screw into holes in the rear of air chamber, one on either side of intensifier, a cross-piece to be applied on the piston rod, and a compressing screw with lever.

*Pressures.*—The diaphragm of air chamber will stand a pressure of 500 lb. per square inch, and the complete air chamber, with intensifier, a pressure of 1,200 lb. per square inch.



*Action.*—When the buffer and air chamber are charged (see care and preservation, page 54) before firing, the liquid in the buffer is in front of the piston, and on firing, the cylinder of the buffer is forced into the air chamber; when the liquid passes behind the piston, through the port, the resistance offered by the fluid checks the recoil, assisted by the resistance of the compressed air in the chamber on the cup-shaped end of the cylinder. Air displaced by the advancing cylinder is forced into the rear portion of the chamber through small holes at the centre of the diaphragm, at a pressure about equal to three times that of the initial pressure; this increased pressure, over the normal, acting on the piston of the intensifier through the small port, accelerates the force of the liquid through the pipe on to the gland. The compressed air thus stored up, on complete recoil, pushes the hydraulic buffer cylinder forward, and in doing so brings the gun to the firing position. The controlling plunger on entering the hole in the piston rod displaces the liquid received when the cylinder was in the rearward position, the liquid returning through the space between the flat on the plunger and the hole in the piston; the resistance of the liquid on the plunger prevents the gun running up too rapidly.

*Carriage, Shields, and Sighting Platforms.*

(Plates XIX and XX.)

The carriage (H) consists of two side brackets, built up of steel plates and angles with cradle trunnion bearings, which are strengthened by a casting riveted on to the outsides; these castings have projections for the supporting screws of the ball bearings of the cradle. The sides are connected by having two front, two rear, and two intermediate transoms of steel plates and angles riveted to them. Two bolsters or box transoms are fitted to the underside of the carriage, each one, front and rear, has an upper roller path fitted to its under surface to take a bearing on the live roller ring (HH), which is the same as for the Marks III and IV barbette carriages. Two plates for connecting the carriage to the pivot are fitted to the carriage, one between the box transoms, the other at right angles, riveted together and to the box transoms; there is a hole in the centre, where these plates cross, fitted with a metal bush for the pivot plug. An iron block or plate is bolted to the breast transom, to which is secured the front clip plate. The front and rear clip plates (I and J respectively) are bolted to the carriage and engage under the outer flange of the pivot plate.

The carriage is provided with steel cap-squares, screwed down, for securing the cradle in its bearings. A wood stop to limit elevation is secured at the rear transom, and two steel stops to limit depression are secured to the stays carrying front shield. Wooden covers are provided to keep out dirt and grit from the live roller ring, see page 54. The upper part of the mounting is reached by stairs in the work.

*Shields.*—Four shields are provided: one for the protection of the shell pit, which also answers the purposes of a platform from which the sighting platforms are reached, loading arrangements, &c., are attended to, while to its underside a circular overhead railway is constructed for the projectile trollies: another, the front shield, is for general protection: while two small side shields are principally for the protection of the air chamber.

The circular shield for shell pit (K) is 27 feet 9 inches diameter, and consists of cantilevers made up of plate and angle steel,

supported by knee brackets fixed to the carriage, namely, two on each side and ends;  $1\frac{1}{4}$ -inch steel plates are riveted on top of the girders to form the platform. Near the outer rim of the shield is a flange of sufficient depth to admit of the shell trollies running on top of its inside flange, termed the outer rail; an inner rail with a similar flange is fixed to the girders of the shield by knee brackets; the gauge of the rails is 3 feet 9.2 inches. A short length of the inner rail is made removable at the rear by being secured with bolts and nuts, instead of rivets, so that the trollies may be removed when required. A grating is provided on each side in front, and openings in rear for the projectile hoist, and loading gears for which there are hinged cover plates or doors. The opening between the doors for the rear hoist is now covered by flaps, which are opened and closed automatically by the hoist. Guards are fitted to the upper portion of the outer ram to prevent the flaps fouling the tray when being lowered. These hinged doors with flaps must be opened wide when firing at high angles of elevation to allow the gun to recoil free of the shield, and at the same time a pin in the side of the carriage limiting elevation is removed (*vide* instruction plate on the carriage). Plates of sheet lead are fitted on the top of the shield and automatic flaps, in order to give the numbers working the gun a secure foothold.

A *sighting platform* (L) is erected at each side of the carriage on top of shield.

The *trollies* (M) are for carrying the projectiles on their sides from the front hoist (N) of the pit to the loading position or rear hoist (O). Each consists of a steel frame mounted on four flanged rollers of 5.75 inches diameter across the flanges, with a clip plate at each end; a wood buffer or striker block, furnished with a rope handle, is bolted on to each side of the frame, and a wood housing block, a pair of steel hinged bearing straps, secure the shell in transit. The outer clip plate of the trolley has a groove to engage two spring catches, which secure the trolley in a position suitable to the hoists, that for the front position is on arm (P), secured to the parapet of the work, and the other to a bracket (Q) on the outer rim of the above mentioned shield.

The *front shield* (R) is a 6-inch steel plate, made in halves, and fitted together when in position by a steel butt plate and screws on the inside. The shield is winged to the rear and splayed outwards at the bottom; it stands on the shell pit shield, and is secured to the carriage by steel elastic stays with disc springs. The front is cut away to suit the gun, and also for the sights.

The dimensions are 10 feet 4 inches across the front, and 8 feet at the sides.

The *side shields* (S) are two 4-inch steel plates, each one is secured to the carriage by steel elastic stays with disc springs; they are on top of the shell pit shield.

#### *Elevating Gear.*

#### *Plate XXIII.*

This gear admits of 15 degrees elevation and 10 degrees depression, and is so arranged that both can be obtained from either side of the carriage, from the sighting platforms, or by an extension of the gear which is worked from the floor of the pit at the left side, the former being slow-motion gear and the latter quick.

The gear generally consists of a powerful cross-shaft working in bushes in the carriage sides, and further supported centrally by a steel bracket screwed to the front box transom. This shaft carries two arc pinions which gear with the arcs of the cradle, and a steel worm wheel on its outer end at the right side of carriage. The worm wheel is provided with a friction clutch formed of alternate steel and gunmetal rings, eight of each kind, and two jamming plates, the inner being of gunmetal and the outer of steel, all of which fit on the hexagon flats of the shaft. The adjustment of these is effected (to prevent the gun running down when at extreme recoil) by means of a No. 56 spring disc and two steel nuts on the shaft outside of worm wheel (see also care and preservation, page 53). The worm wheel just described is in gear with a worm on the third-motion or worm shaft working in metal bearings, and to reduce friction as much as possible in these bearings, an anti-friction ring is fitted on each end of the worm, each one consisting of one outer and two inner steel rings, and 23 steel rollers. The worm shaft is in bevel gear with the vertical second-motion shaft, working in bearings secured to a plate bracket on the front of the carriage, and having on the upper end a bevel pinion in gear with another bevel pinion on the first-motion shaft, working in bearings in casting (a). This last mentioned shaft is actuated by the handwheel (b).

The first and second-motion sections of the gear on the left side are similar to those just described for the right side, both these side gears are connected by a cross-shaft having a bevel wheel on each end, gearing with similar pinions on the vertical second-motion shaft. This cross-shaft is supported in metal brackets on the outside of the carriage and on the inside of the breast transom.

The section of the gear to be worked from the pit is a continuation of the vertical second-motion shaft, left side, and a bevel wheel on its lower end, which is in gear with a similar pinion on a first-motion spindle which is actuated by the handwheel (c). This section of the gear is principally supported in a cast steel bracket secured to the underside of the front box transom. This bracket is also prepared for the lower section of traversing gear.

#### *Elevation Indicator Gear.*

This gear is so constructed that the range required will be indicated on the dial by a pointer. It consists of an arc, which is attached to the front of the left elevating arc, in gear with a spur pinion on a short cross shaft working through the left cheek of the carriage, supported by a bracket on the inside of the cheek and a dial or disc bracket on the front box transom. Fitted on the outer end of the cross-shaft is a dial or disc, having a yard scale engraved upon it, the range being indicated by a pointer secured on the underside of the rim of the dial bracket by two screws.

All the parts are made of metal, except the cross-shaft, which is of steel.

In latest manufacture the dial or disc is graduated in separate range scales for full, and three-quarter charges, and an adjustable pointer is provided. The pointer consists principally of an open frame with a sliding plate, which may be clamped to the frame by a nut to expose either one of the scales, and at the same time mask the other.

*Traversing Gear.**(Plate XXIV.)*

The traversing gear is arranged to be worked practically from the same positions as the elevating gear, and is generally secured to the carriage in a similar way; and like it the lower is quick motion and the upper slow.

The driving, or rack pinion, is at the right front of the mounting. Its shaft works in a metal bush secured in the box transom of the carriage, and carries a spur wheel which is in gear with a spur pinion on the lower end of a short spindle having a spur wheel at its upper end in gear with a spur pinion on a vertical second-motion shaft, at the upper end of which is a bevel wheel in gear with a similar pinion on the first-motion spindle, which is actuated by the handwheel (a) with folding handle.

The upper part of the left side gear, is similar to that on the right side before described, and is connected to it by a cross shaft in a similar manner to the upper part of the elevating gear.

The section of the gear to be worked from the pit is similarly arranged to that portion of the elevating gear, being a prolonged second-motion shaft in bevel gear, a first-motion spindle, and hand-wheel (b).

Stops are provided so that practice may be kept within safe lateral limits. These consist of two buffer stops, each including a steel bracket carrying a spindle with two pairs of disc springs, nut and keep pin, the brackets being secured to the pivot plate by screws, and a steel stop, which is secured to the front clip plate of the carriage by screw bolts.

*Sighting Gear.*

*Rocking-bar sights, Plate XXV.*—This gear is on the left side of the mounting, supported by a metal bracket (a), secured to the front transom of the cradle. It consists principally of carrier (b), rocking bar (c), sight bar (d), with front and rear sights (e, f), and telescope (g).

The steel carrier is attached to the arm of the supporting bracket by screws with either T-shaped heads or hexagon heads (h). A worm wheel and pinion gear actuates a 6-inch drum, on whose periphery there is a crown metal yard scale ring graduated to 14,000 yards range, with M.V. of 2643 f.s. for full charge; there is also a 4-inch drum with yard scale ring for three-quarter charge, the ring being engraved to 12,000 yards, with M.V. of 2196 f.s., and a separate yard scale ring for the 4-inch drum is provided for use with the aiming rifle; and to facilitate reading these yard scale rings, a steel pointer (special to each diameter of drum) is fitted at the rear of the carrier.

The rocking bar is connected to the carrier, in front by the pivot pin (i), and in rear by the arc (j); the front end is prepared for the pin of sight bar; the rear end for the traversing pin or nut, and a crosshead with deflection leaf graduated to 2 degrees left and right, which is worked by a screw with milled heads, 3 degrees being allowed as correction for drift; the arc on the underside of the bar has teeth on the front face to gear with the pinion on the carrier, and in rear a scale graduated to 15 degrees; a stop on the lower end of the bar prevents it running out of gear.

The sight bar is a steel tube that carries the sights. The fore sights consist of an acorn on a lug of the bar, and a sighting blade on a hexagon at the front of the turning rod within the bar or tube; the rod is secured by a nut and screw, and can be turned down when not required by the thumb piece (*k*); a spiral spring on the turning rod at the rear, within the tube, retains the sighting blade in position. The rear sight is on a lug secured to the sight bar; it has a .06-inch notch.

A telescope is provided for laying on distant objects, or when extreme accuracy is required. The telescope fits in two holders on the sight bar, and is capable of being adjusted to suit different layers, the holders being provided with hinged caps to retain the telescope in position. For description see page 37.

For convenience of the gun layer, an adjustable shoulder piece is provided. The stock is of walnut wood, with an elastic pad formed of a length of indiarubber tube, which has its upper end protected by a brass cap secured to the stock by screws.

*Automatic Sight, Plate XXVI.*—The automatic sight gear is on the right side of the mounting. It is automatically set to the range corresponding to that of the target, by use of a cam action. All that is necessary for use is to align the sight with the target. A correcting gear is connected to the traversing rack to adjust the auto-sight cam with the cradle trunnion axis for any inclination there may be in the pivot.

The gear generally consists of a telescope (*a*), supported in a gunmetal carrier (*b*), a gunmetal hinge flap (*c*) for carrier, gunmetal bracket supporting hinge flap (*d*), gunmetal lever cam roller (*e*), metal bushed at each end, manganese bronze cam roller (*f*), cam (*g*), cam sliding block (*h*), cam tidal correction lever (*i*), and graduated arc (*j*), and spring in gunmetal case (*k*). The above are supported by a steel bracket (*l*) attached to the front transom of the cradle at the right side; this bracket is metal bushed to take the pivot of the cam roller lever, the pivot being allowed 3 degrees inclination correction for drift, and is adjusted by a set screw on top of the bracket.

The telescope is secured in the carrier bearings by steel caps which hinge on the left side and kept down by screw clamps on the opposite side. On top of the carrier is a clinometer plane. Deflection is obtained by the carrier and hinge flap being pivoted near their front ends, there being a traversing rack formed on the rear of the carrier to gear with a worm spindle on the hinge flap; this worm spindle has a drum on its right-hand end, the drum has a crown metal deflection scale on its periphery graduated for 2 degrees right and left deflection (and in order that the direction for turning may be clearly indicated, the words "right" and "left" with directing arrows are engraved on the ring); a reader to indicate direction, &c., is also provided. The hinge flap is connected to the supporting bracket (*d*) and is given a vertical movement by a joint pin in front and an "error of day" nut arrangement in rear, the nut being clamped by a jamming lever; there is a reader on the rear of the bracket (*d*) to facilitate reading the nut graduations. The bracket (*d*) slides into and is secured on top of the cam roller lever, the latter being pivoted to the steel bracket (*l*) on cradle; the lower end of this lever carries the cam roller, which is kept up to its work by the steel spring (*k*); one end of the spring spindle is attached to the eccentric spindle of the cam roller, the other end being attached to the carriage. The cam is fixed to the sliding block in the guide (*m*) secured to the carriage by screws, the block with cam being actuated as to level of racer

by the eccentric rod of the correcting gear. There is a separate cam for the full and three-quarter charges, but these cams are substituted by one cut to the range limit of the 1-inch aiming rifle, when required, so as to give increased practice in laying with these sights. Adjustment of the cam for tide level is effected by the lever (i) which is connected to the cam, and works on the metal graduated arc (j), showing rise and fall of tide, the lever being clamped on the arc by a fly nut.

For convenience in laying the gun a shoulder piece is provided as for the "rocking-bar sights" before mentioned.

*Bar, testing, sighting gear, automatic and rocking bar, Mark I.*—The bar, which is of cast iron, is for use in testing, by means of the Service Clinometer, the accuracy of the telescope holders on the sight bars of automatic, rocking bar, and combined automatic and rocking-bar sights of B.L. and Q.F. carriages. It is formed at each end to fit the telescope holders, the intermediate portion having a plane for the clinometer. An arrow head is engraved on the rear end, which will be set to correspond with a similar arrow head on the rear telescope holder.

In future, when testing the angle between the gun and the sight, the clinometer readings will be taken from the bar (fixed to the holders) instead of from the plane formed on the rocking bar.

In the adjustment of auto-sights the last motion of the elevating gear must be depression, except for any particular mounting with which it is ordered that the last motion must be elevation, and, moreover, the gun should be balanced as if loaded.

For care and preservation, see "Regulations for care and preservation of Artillery Matériel."

#### *Loading Arrangements.*

These generally consist of a steel arm with loading tray, a front and a rear hydraulic hoist with accumulator gear, and a derrick with windlass and tackle as an auxiliary arrangement.

The *steel arm* is made of plates and angles riveted together; it is bolted to a projection at the left rear of the cradle, the outer end is prepared for a joint pin upon which the tray pivots.

The *tray* is of metal connected to the before-mentioned steel arm by the joint pin, a spring locking bolt being used for securing it in the required position; a steady pin with locking catch is provided to engage a corresponding hole in the left face of the bronze end frame of the gun. The tray is intended to protect the screw threads in the breech of the gun while the projectile is being rammed home. After the cartridge is loaded the projectile tray is swung back and the breech closed.

The *Derrick Gear*.—The derrick is made of two steel curved plates connected by collar bolts, and secured to a pivot piece by screws; the pivot piece is flanged and tapered, and provided with two bearing surfaces which fit into corresponding metal bushes in the lugs of a steel bracket at the left rear of the carriage. It is fitted for a fall of rope  $44\frac{1}{2}$  feet long with a sheave block with hook and thimble. For this purpose a shackle and three gunmetal guide sheaves (fitted with steel guards to prevent the rope from leaving the sheaves) are fitted to the plates of the derrick. One end of the rope is spliced to the shackle at the top of the derrick, the other end is rove through the sheave block, over the guide sheaves, down through the hole in the pivot piece of derrick, and then spliced to the thimble which



is secured to the windlass drum by a pin. A rope guide is also fitted to the mounting, immediately above the windlass, in order to afford additional protection to the rope.

The windlass consists of a cast-iron drum with ratchet and band brake, and a spindle with a No. 35 winch handle; it is attached to the underside of the rear box transom of the carriage, immediately below the derrick, by means of a cast-iron bracket.

When using the derrick the projectile is brought to the rear of the carriage in a barrow, and then raised from the pit to the loading tray, which is then swung round to the breech of the gun.

*The Hydraulic Gear.—Plate XXIIa*—By means of the compressors on the cradle, a quantity of the energy of recoil is utilized in supplying hydraulic pressure for the loading gear.

The compressors are connected by a system of pipes, to a spring accumulator, fitted with a tank,\* installed in the work; which in turn is connected by another system of pipes to the front and rear hoists.

The compressors (or hydraulic cylinders) are provided with rams which are connected to the crosshead on the gun, so that when the gun is fired, the liquid in the compressors is forced through a connecting pipe and non-return valve into the accumulator, causing the springs to be compressed and consequently storing up the energy of recoil, for the working of the hoists.

As soon as the gun runs up again a vacuum is created in the compressors, and liquid is drawn through a suction valve from the tank and by the connecting pipe to the compressors.

A relief valve is fitted to the tank to meet the possibility of the gun being fired when the accumulator is in such a state of compression that there is not room for the liquid from the compressors to enter the centre cylinder of the accumulator. When this occurs the valve opens and discharges the liquid into the tank (instead of bursting the pipe). The spring, however, is sufficiently strong to keep the valve closed under ordinary conditions.

The hoists are known respectively as "front" and "rear." The front one is fixed in the floor of the emplacement, and is used to raise the projectiles from the barrow to the trollies on the circular railway. The rear hoist is secured to the rear of the mounting and moves with it, and is used for raising the projectiles from the trollies to the loading tray. The hoists are provided with rams, the top of each being fitted with a bearer for supporting the projectile.

The pressure to the hoists is controlled by control valves, actuated by lever handles, and the liquid in the hoist cylinders, when the ram descends, after raising a projectile, is allowed to escape through an exhaust pipe back to the tank of the accumulator.

To obtain the initial pressure in the accumulator a pump is provided; this could also be employed to restore loss of pressure in the compressors.

A syphon is provided for reducing as required the quantity of liquid in accumulators which are fitted with extending boxes.

The chequered plate immediately over the accumulator pump is now fitted with two steel stops with bolts to limit the stroke of the accumulator pump lever.

The gun may be loaded at 5 degrees elevation or depression in any position of traverse.

---

\* The tank has been deepened by the addition of an extending box fixed above. An emptying hole is provided in the box, which is closed by a No. 10 plug.



Six trollies, *see* page 42, are provided, which convey projectiles from the front to the rear hoist.

The front hoist may be worked at any time, so that two or three projectiles may be ready to run over the rear hoist.

With this gear the projectile is brought in a barrow and laid in the tray of the front hoist (N) (Plate XIX) in the floor of the pit; two brass plates are fixed to the covering plate of the hoist to indicate the holes in which the feet of the barrow should be placed for each nature of shell—"Armour-piercing" and "common lyddite." The projectile is then raised to and secured in an overhead trolley (M), which is run round to the rear hoist (O), to which the projectile is transferred and raised to the loading tray, the latter being swung into the breech chamber before the former is raised.

Weight of accumulator about	3 tons	10 cwt.	0 qr.	0 lb.
" front hoist	0	" 10	" 2	" 0
" controlling valve	0	" 1	" 0	" 5

#### *Gear firing, Electric.*

This gear, which is similar to that for Mark IV, is arranged on the mounting so that the gun can be fired from either side, or from the position finder station; in the latter case a safety plug is provided for use in conjunction with a safety plug box.

The gear generally consists of two contact boxes, a pistol grip, safety plug box, two connectors pistol grip, connection cable to battery box, battery box containing four electric Le Clanché cells with connecting wires, and six cables.

The *contact boxes* are of gunmetal, and are called "boxes, contact, sliding; plug, No. 2, and plate, No. 2." The plug is of gunmetal with cap, contact plug in two parts, spiral spring, insulating bush, and washer, releasing lever and flat spring, with two fixing screws (automatic circuit breaker). The plate is of gunmetal, with contact plate, insulating bush in two parts and fixing screws (automatic circuit breaker), and they are fitted to suitable brackets. The contact boxes are arranged to break the circuit automatically during the recoil, a releasing lever being attached to the plug contact box by which the contact boxes may be approximated when it is required to complete the circuit.

The *pistol grip*, *Mark III*, is the same as that for the Mark IV carriage. *See* page 32.

The *safety plug box* is of gunmetal, and is provided on the outside with screwed holes to receive the cables, one of which is closed by a mill-headed screw for the cable from the position finder.

The *connectors, pistol grip*, are made to receive the Mark III pistol grip and the electric cables. One connector is attached to the holder on the right side of the carriage, and the other to the socket formed in the shoulder piece pintle. The connector consists principally of a socket with jamming block and clamping screw to secure the pistol grip, and a gunmetal block with means for attaching the cables. A hinged cover plate on the socket protects the terminal clips within the socket when the pistol grip is withdrawn.

The *battery box* and *electric battery*. These are the same as for the Mark IV carriage, *see* page 32. For care and preservation of electric firing gear *see* page 54.

The six *MI* electric cables are copper wire braided, with connecting nuts as for those for the Mark IV carriage, but their numbers, etc., are as follows:—

		ft.	ins.		
A.	No. 2.	8	4 $\frac{1}{2}$	..	White; from gun to sliding contact.
B.	No. 2.	18	4 $\frac{1}{2}$	..	Purple; from sliding contact to safety plug box.
C.	No. 2.	11	9	..	Red; from right-hand pistol grip connector to safety plug box.
D.	No. 2.	16	3 $\frac{1}{2}$	..	Yellow; from right-hand pistol grip connector to battery.
E.	No. 2.	6	4 $\frac{1}{2}$	..	Black; from left-hand pistol grip connector to safety plug box.
H.	No. 2.	9	6	..	Uncoloured; from left-hand pistol grip connector to battery.

The following traversing arc, holdfast, pedestals, pivot plates, pivot plug and cover, are used with this carriage.

(Plate XIX.)

ARC, TRAVERSING, No. 34 (MARK I).

The arc is fixed on below the flange of the pivot plate, at (T), for description, *see* Mark III carriage, page 28. A pointer for indicating the angle of traverse is fixed to the carriage.

HOLDFAST, CARRIAGE PEDESTAL, No. 4A.

This holdfast (U) is identical with that for Mark III carriage, page 29.

PEDESTAL, CARRIAGE, No. 4.

This pedestal is the same as for the Marks III and IV carriages and is used with six Mark V carriages mounted at Dover.

PEDESTAL, CARRIAGE, No. 7.

This pedestal (V) is a hollow iron casting, cast in halves and bolted together by means of junction plates and bolts when the pedestal is placed in position. The top and inside surfaces are prepared to take the pivot plate, and 3 raising screws are provided.

The pedestal is secured to the work by the holdfast.

Weight 17 tons 8 cwt. 1 qr.

Mark II pedestal differs from Mark I in not being provided with levelling screws, an automatic correcting gear being used instead.

Weight 16 tons 16 cwt.

PLATE, PIVOT, No. 4, CARRIAGE PEDESTAL.

The No. 4 pivot plate (W) is of steel; with racer and traversing rack with fixing screws. It is used on No. 4 pedestal with the six carriages mounted at Dover.

Weight 8 tons 12 cwt. (including bolts).

(9389)

n

### PLATE, PIVOT, No. 7, CARRIAGE PEDESTAL.

This is of steel (W), cast to shape and fitted on top of the pedestal by bolts on either side of racer, there are 30 bolts on the outside and 16 inside of the racer. In the centre of the plate there is a hole having a shoulder to suit the pivot plug. There is a flange on the underside to take a bearing against the inside face of the pedestal, while another flange cast on the outside rim gives a bearing to clip plates of the carriage.

A segmental traversing rack (X) is secured above the clip plate flange of the plate by screw bolts.

Weight 8 tons 16 cwt. 1 qr. (including bolts).

### PLUG, PIVOT, No. 19.

This is of steel, with securing plate and screws. The plug (Y) has a flange to take a bearing on the shoulder of the hole in pivot plate and in bush of carriage. It is prevented from turning by a steel feather let into a feather way. The plug is prepared for the pipe (Z) of the hydraulic gear, and is for use with Nos. 4 and 7 pedestal pivot plates.

Weight 6 cwt.

### COVER, CARRIAGE, B.L., 9'2-INCH, MARK V., BARBETTE (MARK I).

This is similar to the Mark III barbette carriage cover already described.

### TRAY, SPARE PARTS.

This is made of deal or pine, and sub-divided into compartments, similar to the "box, spare parts" for the gun, *see* page 14, of such a size as to hold the necessary spare parts to be kept for the number of carriages in the work.

The tray is made locally.

---

## CARE AND PRESERVATION OF CARRIAGES.

*See "Regulations for Magazines and the Preservation of Artillery Matériel."*

### SPECIAL INSTRUCTIONS NOT IN THE ABOVE-MENTIONED REGULATIONS.

Shafts and spindles having nuts secured by taper pins will be marked to correspond with each other to prevent the nuts being placed on the wrong shafts or spindles. When necessary, nuts, shafts, or spindles will be marked locally, with a letter or punch mark as most convenient.

Whenever any parts are found broken, defective, or deficient which cannot be renewed by the artificer, fresh parts should be demanded at once. Any damage occurring at drill or practice should be at once reported, with a view to being made good without delay.

Covers for the protection of the cams of auto-sights of Mark III mountings for Mark IX guns will be provided locally.

*Care, &c., of Barbette Mountings.**Mark III.*

Before the erection of the mounting is commenced special attention must be directed to the following points:—

- (a) The racer must be perfectly level.
- (b) The roller path, upper and lower teeth of traversing rack, rollers, and the underside of the rack where the clips engage, must be quite clean, and free from burrs.
- (c) It should be seen that the roller ring has not been bent.

The rollers and axles must be oiled, placed on the roller ring, and the ring given two or three revolutions on the roller path before putting on the mounting, to make sure that it runs truly.

The upper roller path should be cleaned and oiled, and any burrs removed, the mounting should then be lifted into position. The traversing gear and pointer should then be attached, and one or two revolutions made to see that the mounting traverses truly. The level of the racer may be tested here by a spirit level placed on the mounting. Put on the clips and make another revolution to ascertain that they do not bind on the clip ring. The angular segment plates connecting the front and rear bolsters, and carrying the side platforms and ladders, should be fitted before placing the slide on the ring.

Particular care must be taken that the elevating band, elevating arc, and pinions are put together correctly, or otherwise damage may occur. The friction clutch in the worm wheel should be tightened just sufficiently to prevent the elevating arc running down itself when the gun is mounted. The clutch consists of alternate plates of steel and metal, and their surfaces should be slightly oiled. The gear should be elevated and depressed frequently to prevent the trunnions adhering to the bearings.

Before connecting the piston rods to the slide, they should be pushed in and out to see that they work freely, and that the packing glands are not too tight.

*To Mount the Gun.*—When the gun has been placed in the trunnion holes, secure the elevating band and arc in position, insert the cap-squares and secure them by pins, and fix the ball bearings in position on the spindles. Then raise the gun on its ball bearings until it pivots freely in elevating; they should be slightly lubricated only.

*Hydraulic buffers.*—Before removing the buffer glands for renewal of the leathers and packing, the gun must be run back to the most convenient position. The lengths of packing should be well greased before use, taking care that when putting them in, the joints of the packing rings do not come opposite each other. Great care should also be taken in putting in the L leathers in the buffer glands, to see that the edges enter properly without being damaged.

In cases where it is found that the guns do not run up to the front stops, a flat surface will be filed on the controlling plunger, or screw plug of controlling plunger, to allow of the gun running up to the stops without violence.

*To Prepare for Firing.*—Run the carriage out to the front stops, then remove air plugs from both cylinders, and pour in oil through one hole until it overflows at both, and draw off  $\frac{1}{2}$  pint, i.e.,  $\frac{1}{4}$  pint from each buffer, then replace plugs.

Contents  $9\frac{1}{2}$  gallons of mineral oil.

*Mark IV.*

The instructions for the care of the Mark III mounting will generally apply to the Mark IV, except buffer gear. And in addition the following:—

*Gun Attachments.*—To prepare the gun for mounting:—Place the lower half of the gun band in position. Over the trunnions of the gun place the sliding blocks, which are of H section, at the same time seeing that the front ends of the blocks overlap the lower half of the band; then secure the blocks to the band by the steel screws. Place the upper part of the band in position and bolt up.

*To Mount the Gun.*—Remove the guide clips from the cradle, release the piston rod from the front brackets of the cradle, and push back the buffer tube with piston rod until there is a clearance of about 3 feet from the front end of the bracket. Place the gun with its attachment in the cradle, refix the clips to the sides of the cradle, then pull the buffer tube forward until it engages with the gun band, and secure the piston rod to the front transom. It may prove more convenient to force the buffer tube forward by slight air pressure pumped into the air chamber.

When the cradle is mounted in its bearings on the carriage, secure the elevating arcs to the sides of the cradle, screw on the cap-squares, and fix the ball bearings in position as for Mark III mounting.

*To Prepare for Firing.*—Charge the intensifier and main gland by pumping in oil at (A<sup>1</sup>), which is at the left side of intensifier, let air escape at (C), which is on top of air chamber near the front. The piston rod of the intensifier may also be forced in by a screw clamp, and the oil then poured in at plug (A<sup>1</sup>).

Charge the air chamber through valve (D), which is at the rear of air chamber, to a pressure of 200 lbs. per square inch. About 3 quarts of oil should be in the air chamber.

With the gun at elevation, fill the buffer with oil by pumping in at (E), which is at the underside of buffer cylinder, near the front, let air escape at (B), which is on top of buffer cylinder and over valve (E).

Contents 9½ gallons of mineral oil.

*Mark V.*

Before the erection of the mounting is commenced, special attention must be directed to the following points:—

(i.) In cases where 132° 30' traverse on either side of the centre line passing through the front and rear of the emplacement is required, it must be noted that the centre line of the key way for the pivot plug should be 2¼ inches to the left rear of the centre line of the emplacement. Where more than this traverse is required, the telescopic exhaust pipe should be replaced by a sphincter grip hose; and the traverse should be limited by means of the traversing stops.

(ii.) The stops for limiting the angle of traverse, which are to be fitted locally, must be so arranged that when the springs on the traversing stops are compressed, the telescopic exhaust pipe is clear of the centre pivot pipe bend.

(iii.) The instructions as to level of racer, correctness of upper path, and live roller ring before mentioned will also apply to this mounting.

*To Mount the Carriage.*—The carriage is mounted on the live roller ring, the centre pivot in position, and the clip plates secured; the carriage should then be given two or three revolutions to see that it works correctly.

*To Mount the Cradle.*—Mount the cradle in its trunnion bearings, the elevating arcs being previously attached, screw on the capsquares and fix the ball bearings in position on the end of the trunnions. Attach the hydraulic pipe to the swivel joint on the left hand trunnion.

*To Mount the Gun.*—Before mounting the gun it must be raised on to skidding, to allow the lower half of the gun bands to be placed in the correct position. Place the upper parts of the bands to exactly correspond with the lower parts, and secure them inflexibly together by the clips on the sliding bars; the latter connect the front and rear bands, and are secured to them by steel screws.

The gun with its attachments is now ready for mounting. Remove the guide clips from the cradle, and push the compressor rams into their cylinders. Run back the buffer tube on the piston rod until it has a clearance of about 12 inches from the front stops. Place the gun with its attachments in the cradle, refix the clips to the top of the cradle, secure the lower cap on the front band, also the nut on the recoil buffer stuffing box, and the compressor rams to the lugs on the front band; it may prove convenient to force the buffer tube into the recess on the lug of the front band, by slight air pressure pumped into the air chamber.

Care must be taken before firing that the plates of the friction clutch of the elevating gear are quite free from grit, oil, or liquid, in accordance with instructions which will be found in the "Regulations for Care and Preservation of War Matériel, &c."; in putting the clutch together, and to tighten it up sufficiently, the power of four men will be required on the special spanner.

Fill the buffer tube in strict accordance with the instructions on the plate on the side of the cradle.

Mineral oil is used in the buffer, which will be invariably kept filled, and before filling care should be taken that the gun is within 2 inches from the front stops. Before replacing the air-hole plug it should be seen that as little air as possible remains in the buffer. This may be minimised by raising the gun a few degrees from point blank while filling the buffer. To ensure the controlling plunger chamber being full of liquid, slacken the gland on the front end of the piston rod, and pump in liquid until it passes the gland.

No permanent alteration should be made in the pressure laid down for the air chamber, and it should be noted that the pressure gauge is giving correct record.

Before firing it should be ascertained by removal of the air screws in the compressors, that the latter are full of liquid, to ensure the accumulator being properly charged during recoil. It is also important that the lever of the controlling valve for the front and rear hoists is in the central position, and all valves are properly tight upon their seatings.

*Packings.*—By pumping liquid into the buffer cylinder, the gun may be run back to a convenient position for removal of the small gland and the renewal of the hydraulic packing; but for renewal of the L leather the buffer of course must be emptied and the stuffing box removed, the gun being properly secured in a suitable run-back position. The packing is the service "hydraulic"; it is woven square in section with a rubber core, and is supplied by length. For

use it is cut into full lengths, which are prepared and adjusted in the usual way.

To facilitate repacking of ram cylinder glands of accumulators, two sleeves will be used to support the spring block.

The ball bearings of the cradle trunnions should be properly adjusted and kept well lubricated.

For care and preservation of the electric cables, see page 55.

*To Prepare for Firing.*—Charge the intensifier and main gland by pumping in oil at the valve marked (A<sup>1</sup>); which is on the right side of air chamber near the rear, let air escape at (C), which is on top of air chamber near the front. The piston rod of the intensifier may also be forced in by screw clamp (for description, see page 40), and the oil then poured in at (A<sup>1</sup>), using a funnel.

Charge the air chamber through valve (D), which is at the rear of air chamber, to a pressure of 200 lbs. per square inch, about 3 quarts of oil should be in the air chamber.

With the gun at elevation, fill the buffer with oil by pumping in at valve (E), which is at the under side of buffer cylinder near the front, letting air escape at (B), which is on top of cylinder over (E).

*Liquid for—*

Hydraulic buffer—9½ gallons of mineral oil, normal quantity per carriage.

Accumulator system—74 gallons of “fluid, lifts, and jacks, hydraulic,” normal quantity per carriage, but as the distance of the accumulator from the carriage is not the same in all emplacements additional fluid will be supplied when required.

On completion of the first firing, after erection, the whole of the liquid shall be pumped off from the accumulator system and filtered before being replaced.

#### *Protecting Wooden Covers for Roller Ring.*

The covers, which are right and left, are for protecting the exposed portions of the roller path and ring from dirt and grit. They are made and fitted locally to carriages received without them.

### INSTRUCTIONS FOR THE USE, CARE, AND PRESERVATION OF ELECTRIC FIRING GEAR.

#### PISTOL GRIP MARK III. (Plate XXVIII.)

##### *Description and Use.*

The Mark III pistol grip enables the tube and the circuit generally to be tested at the moment before firing, in a similar manner to the battery and key test and firing.

The letters used in the following description refer to those on the plate referred to above.

It can be used on any mounting fitted with the connector (E) and the necessary firing cells and leads.



In addition to the trigger (A), there is a lever (B) (called the "lever, contact"), the functions of which are:—

- (1) To lock the trigger (A), and prevent it being moved by accident; and
- (2) to close the circuit through the indicator (C), by means of the plunger (D).

In order that the layer may see the indicator disc from above, the cover is polished on the inside face, and can be set at any convenient angle.

The testing current is insufficient to fire the tube, but when the trigger is pulled, the indicator coil is short circuited, and the tube fired.

#### *Care.*

The pistol grip, when inserted in the connector and secured by the clamping screw, must not be turned round while so secured, nor any attempt made to remove it from the connector, until the clamping screw has been fully unscrewed. Before use, the contact lever and trigger should be worked to see whether all the parts are free and in proper working order.

#### *Preservation.*

The pistol grips, when not in use, should always be kept in the wooden box provided for them.

They should not be taken to pieces, or interfered with in any way, except by those qualified, and then only when authorised to make any special examination or necessary adjustment.

The contacts must not be lubricated, and care should be taken not to drop pistol grips, or subject them to rough usage of any kind.

#### *NOTE.*

The trigger should be unlocked when the indicator circuit is closed. The test for this is as follows:—

Having first obtained an indication by depressing the contact lever (in the absence of a tube it will be necessary to "earth" the striker), release the contact lever and put a steady pressure on the trigger, then depress the contact lever till the trigger is released. The indicator should not appear; if it does, the pistol grip must be returned to store for adjustment.

#### *Box, BATTERY, LE CLANCHÉ, A, 4-CELL.*

The terminals should be opened out sufficiently to ensure good contact between them and the connection cable to battery box. The lid of the battery box should be screwed down sufficiently to make a good joint, and thereby keep out the damp.

#### *CABLES.*

Should be free from kinks, and should not be bent to accommodate itself to the mounting within three inches of the pin contact. If the cable becomes exposed through the removal of the insulating

material, the cable should be exchanged. The pins contact should be kept clean, and free from rust and oil, and the ends opened out sufficiently to ensure a good contact.

#### SAFETY PLUG BOX, AND CONTACTS SLIDING, PLUG AND PLATE.

The holes for pin contacts, the sliding portion of plug and plate, and the safety plug, should be kept clean and free from oil. If, when a cable is to be replaced, there should be any wait for replacement, or if a cable has to be removed for any period, the holes for pin contacts should be plugged with cotton waste to keep out dirt and moisture.

#### CONNECTOR.

The holes for pin contacts and the clip contacts should be kept clean and free from oil. If clip contacts should open out at any time, the block securing cable should be taken out, and the clips closed until they make a good contact with the terminals of the pistol grip. When the pistol grip is removed, care should be taken that the plate cover falls and covers the hole.

#### GENERAL.

All parts making contacts should be kept clean, and free from oil, rust, or moisture.

---

### PUMP, RUNNING BACK, PORTABLE, MARK I.

CARRIAGES, GARRISON, B.L. 12-INCH; BARBETTE, 10-INCH, MARK IV, 9.2-INCH, MARKS III, IV AND V.

(Plate XXIX.)

This pump is used for running back the above mentioned carriages at drill, &c.; it is of the ordinary double-acting hydraulic type, and is designed so that the liquid pressure will act on the pistons of the hydraulic buffers. It is contained in a portable tank, on wheels, so that it may be conveniently moved from one carriage to another.

The pump itself consists of a metal casting (*a, a*) fitted with plungers (*b, b*), which, when actuated by the handles (*c, c*) through (*d*), draw the liquid through the inlet valves (*e, e*), and force it past the delivery valves through the pipe into the hydraulic buffers or buffer, as the case may be; the pressure acting on the pistons of the buffers causes the carriage to run back. When run back, the carriage can be retained in that position by closing the stop valve on the buffer.

The "pipes copper, connecting,  $\frac{1}{4}$ -inch bore," used with the "pump, air, double," and "pump air or liquid" are also used for connecting the portable running back pump to the above mentioned carriages.

Adapters are used for connecting the copper pipes to the portable pump.

Before commencing to pump a carriage back, the tank must be filled to a depth of 6 inches with the same description of fluid as is used in the hydraulic buffers.

When the carriage is run in, the liquid is forced back again from the hydraulic buffer to the tank through the return valve (*f*); this valve must be closed before commencing to pump the carriage back, and opened to run up.

Weight 5 cwt. 1 qr.

The following articles, referred to above, are used with the pump, as indicated opposite them:—

Pump, running back, portable (Mark I):—

Valve, stop, "A" (Mark I) Steel and bronze.

Adapter, pump, running back, portable (Mark I) G.M., with leather washer; for use with copper connecting pipes,  $\frac{1}{4}$ -inch bore.

Pipes, copper, connecting,  $\frac{1}{4}$ -inch bore by 10 feet:— External diameter  $\frac{1}{8}$ -inch.

With unions (Mark I) . . . For use with pump, air, double;  
With union and plug (Mark I) pump air or liquid; and portable running back pump.

## PUMP, AIR OR LIQUID.

(Plates XXX and XXXI.)

Mark I: The pump is double-acting, and is intended for charging the cylinders of mountings with fluid or compressed air, and reservoirs with compressed air. It is contained in a metal tank (*a*) 2 feet  $0\frac{1}{2}$  inch in length and 1 foot  $2\frac{3}{8}$  inch in width, bolted to an iron stand, which is secured to a wood platform. A canvas cover is provided to prevent grit and dirt getting into the working parts when not in use.

The pump consists principally of the following parts:—

(1) High and low pressure plungers; the former (*d*) is fixed to a crossbar (*e*) at the top of the tank, having a gunmetal washer inserted between the seating and the L leather, and the latter (*f*) to the bottom of the tank.

(2) Suction, intermediate (*h*), and delivery valves.

(3) Metal cylinders (*g*), formed at one end to receive the high-pressure plungers, and at the other the low-pressure plungers.

(4) Outer plungers (*i*).

(5) Overflow valves (*k*).

(6) Cock (*l*) for admitting air or liquid to the pump.

(7) Double-handle lever for actuating the cylinders (*g*).

Mark II differs from Mark I generally as follows:—The tank is of an increased depth, in order to ensure the high-pressure plungers being kept wet. Certain of the component parts are of "Delta" Metal, to decrease the liability of corrosion.

*Stand.*

The stand, which is of cast iron, 7 inches high, is attached to a wood platform, 5 feet 9 inches long by 3 feet 5½ inches wide.

*Adapter, A.*

This adapter, which is for use with the connecting pipes of the "Pump, air, double," is a metal casting 2.625 inches long, with connections to suit the discharge nozzle of the "Pump, air or liquid," and the unions of the connecting pipes of the "Pump, air, double."

*Adapter, B.*

This adapter, which is for use with the connecting pipes of the "Pump, air or liquid," is a metal casting, 4.45 inches long, with connections to suit the unions of the connecting pipes of the "Pump, air or liquid," and the "Connection, indicator, pressure," in use with disappearing mountings.

*Pipes, connecting.*

These pipes are each 10 feet long, two with unions at each end, and two with a plug at one end and a union at the other.

*Spanners.*

The spanners, are of steel, formed to suit the various parts of the pump, &c.

*Arrangement of Connecting Pipes.*

The pump is connected to the cylinders of mountings, or to reservoirs, by means of connecting pipes, which may be either those described above, or the connecting pipes of the "Pump, air, double," whichever are available.

When the connecting pipes of the "Pump, air, double," are used for connecting to the cylinder or reservoir, through a separator, the adapter (A) is first screwed on to the discharge nozzle of the "Pump, air or liquid," and the pipes are then connected as required.

When the pipes of the "Pump, air or liquid," are used for connecting—

1. To the cylinder, the adapter (B) is first screwed on to the "Connection, indicator, pressure," in use with the mounting, and the pipes are then connected as required.
2. To the reservoir through a separator, three adapters, (B), are first screwed on, one to the nozzle of the inlet valve, one to the nozzle of the outlet valve of the separator, and one to the nozzle of the valve of the reservoir; the pipes are then connected as required.

*Method of Use.*

*Pumping Air.*—When charging with air, the lever working the cock (I) is turned to the side of the tank marked "air." On the up stroke of the cylinder, air is drawn through the cock, along the

passages, and through the suction valve into the low-pressure cylinder (*n*). On the down stroke of the cylinder the air is forced through the intermediate valve (*h*), and compressed into the high-pressure cylinder (*o*), and on the next stroke of the cylinder is forced through the delivery valve and pipe (*p*) to the cylinder of the mounting or reservoir.

When first commencing to pump air, the area of the low-pressure cylinders can be increased, and, consequently, a larger volume of air pumped, by connecting the outer plungers (*i*) to the bottom of the tank. When the pressure is found to be too high for the pump to be worked by this arrangement, the outer plungers (*i*) are connected to and move with the cylinders (*g*). The outer plungers (*i*) are connected to the tank or cylinders by moving a lever on each side of the tank towards the words "low pressure" or "high pressure" respectively. *The connections must not be made until the cylinder is on the bottom stop on that side.*

*Pumping Liquid.*—When pumping liquid, the lever of the cock (*l*) is turned to the side of the tank marked "liquid," and the plug of the overflow valve is unscrewed sufficiently to admit the liquid in the tank into the low-pressure cylinder (*n*). On the up stroke of the cylinder, the liquid is drawn through the intermediate valve (*h*), which in this case becomes the suction valve, into the high-pressure cylinder (*o*), and on the down stroke of the cylinder is forced through the delivery valve and pipe (*p*) into the cylinder of the mounting.

Belonging to the pump are 4 connecting pipes, 4 adapters (1 (A), and 3 (B)), and 4 spanners, Nos. 157 to 160.

*Weights, &c.*

				Weight.	Tonnage.
				cwt. qr. lb.	Tons.
Pump	..	..	..	3 0 0	0.3695
Stand, with platform	..	..	..	3 2 3	0.451
Maximum working pressure, lb. per square inch, 2,000.					

## PUMP, AIR, DOUBLE, MARK I.

(Plates XXXII and XXXIII.)

The pump is intended to charge the cylinders of mountings with fluid or compressed air.

It consists of two gunmetal cylinders (A and B) of different diameters in one casting, with a base plate, on the top of which an iron frame is bolted to form a tank (C) for the fluid while being pumped into the cylinders. The pump cylinders are fitted with plungers (D), actuated by a rocking lever (E), which is supported on brackets (F) riveted to the tank.

The pump is in duplicate, and is bolted to an iron bedding plate (G), which is secured to the floor by clips (H) and cottars (I). It is worked by two T handles, which are attached to the rocking levers, and are connected at the top by a link to ensure uniform action.

When charging the cylinders with fluid, the fluid is drawn through suction valves from the tank into the large pump cylinders

(A), and on the down stroke of the plunger is forced into the small cylinder through delivery valves. When charging with air the connection between the tank and the cylinders is cut off by closing the valves (K) near the copper delivery pipes, and the air is drawn through a suction valve at the bottom of the large cylinder. This valve is never cut off, but is more heavily weighted than the water valve, and when the water passage is open liquid is drawn in in preference to air, provided the strokes are not too jerky.

Either pump can be disconnected if necessary, and worked independently; the delivery of either is cut off by closing the delivery valve. When this is closed, of course the handle must be disconnected, so that the pump cut off may not be worked.

The pump should be kept in store with the tanks full of liquid, and so used whether air or liquid is being pumped.

To keep the leathers in good order they should be slightly under pressure. To obtain this, screw one length of the copper tubing on the delivery nozzle (J), and on to the other end of the tube fix the blank cap (with packing leather). Then work the pump with the water valves closed until it becomes difficult to move the handles, when the pump may be left—the air in the tubing serving to maintain the pressure obtained.

When standing long in store the pump should be tried occasionally, to see that the pressure is still on.

A cover is fitted to the iron bedding plate to protect the small pipes which connect the base of the pump to the three-way connection.

When it is found that the cylinders of the pumps are defective from excessive wear and scoring, they will be bored to a larger diameter, according to the amount of wear, and fitted with new plungers, and L leathers. The thickness of the cylinders will not allow, at the most, of more than 0.15-inch enlargement, and this amount must not be exceeded. On the enlargement of a cylinder, the word "large" will be stamped on the new plunger.

Belonging to the pump are 4 connecting pipes, 5 spanners (Nos. 96 to 100) and 1 lifting loop.

Weight, 4 cwt. 1 qr.

Maximum working pressure, lb. per square inch, 2,800.

## PUMP, TESTING COMPRESSED AIR RESERVOIRS.

(Plate XXXIV, Figures 1, 2, and 3.)

The body of the pump (*a*) (Mark I) is of gunmetal with steel lever and connections, and copper reservoir (*b*). It is secured to a wood base by four bolts and nuts, the wood base forms part of the box hereafter described.

The plunger (*c*), is of aluminium bronze, and works through a metal gland screwed into the top of the pump cylinder, and a U leather to make a tight joint; the leather is contained in the gland recess. The lower part of the cylinder is closed with a screwed bush with leather washer; this bush contains the inlet valve (*d*), which is grooved on the exterior to give passage to the water from the reservoir, the lift of

the valve being regulated by a screw plug in top of the metal closing bush; and the latter is screw-threaded on the under part to take the metal connection of the copper pipe of reservoir.

A recess in the head of the pump contains a metal outlet valve (*e*); this valve has grooves on its lower exterior, to allow the water to pass out to the compressed air reservoir, and a bronze spiral spring on its upper exterior keeps the valve in its seating; the recess is closed by a screw plug (*f*), and leather washer.

The channel from the outlet valve is continued through a metal bush (*g*), with leather washer, the bush being screw-threaded on the outside to receive the connection of the delivery pipe.

The reservoir (*b*) (which is secured to the side of the pump by a metal band and screws) is of copper, with a connecting pipe (*h*), soldered to it, the other end of the pipe being connected up to the pump, as before stated. Near the bottom of the reservoir is a wire strainer.

The box (Mark I) has a base board with a footboard hinged to it, for the operator working the pump to stand on so as to steady the pump, and which is folded under when not in use. The cover of the box is provided with two metal lifting handles, and is put on over the pump and secured to the footboard by four thumb screws (*i*). The pump with lever and "Gauge, pressure No. 4," page 63, are arranged as shown by the dotted lines in Figure 3, the lever (*k*), and pressure gauge (*l*), must be secured in position in the inside of the cover before the latter is put on.

*Dimensions, &c.*—The box is 19.6-inches deep, 13.5-inches long, and 8 inches wide. The pump, with box complete, weighs 51 lbs., and with pressure gauge 55½ lbs.

*To prepare the pump for use, &c.*

- (1.) Remove the cover of the box and extend the footboard.
- (2.) Attach suitable lengths of the connecting pipes used with the "Pump, air, double," the "Connection, pressure gauges" and the "Gauge, pressure."
- (3.) Partly fill the pump reservoir (*b*), with water.

*Action.*—When the plunger is raised by the up-stroke of the lever the water is sucked from the reservoir (*b*), through the inlet valve (*d*), and fills the space in the plunger cylinder. On the down-stroke the inlet valve closes under the action of the plunger, and the water is forced out through the channel (*m*), the force raising the outlet valve (*e*), which allows the water to pass to the compressed air reservoir. On completion of this action the spring on the outlet valve forces the valve down on its seating and prevents the return of water. On the next up-stroke of the pump lever more water will be sucked into the pump, and so on till the required pressure per square inch, as registered in the pressure gauge for use in testing the compressed air reservoir, is obtained.

## RESERVOIR COMPRESSED AIR,\* MARK II.

(Plate XXXVI.)

The reservoir is for keeping in reserve a supply of compressed air for re-charging the cylinders of disappearing mountings and air chambers of Barbette mountings. It is in the form of a flask.

\* The Mark I reservoir is not so strong as the Mark II; it is not issued for service with these carriages.



with a short neck at one end, which is now being strengthened by having a steel collar screwed on the outside. The neck is fitted with a stop-cock (a), which is used for charging and discharging the reservoir; the outer end of the cock is screwed to take the nut of the charging pipe; the stop-cock is in two pieces, so that the pressure in the reservoir can be cut off, and the outer part (b) removed when the reservoir is packed for transport.

The pressure in the reservoir should not exceed 2,000 lb. on the square inch when in ordinary use, or when travelling.

It should be remembered that more work will be got out of a reservoir, if it is opened to the cylinder with the gun up, in the case of disappearing carriages, than with the gun down, and in getting up pressure from zero with the aid of reservoirs, it will be done more quickly if the gun is allowed to rise.

A preserving plug, valve union, valve key with gland and three grammets are issued with the reservoir.

#### *Care and Preservation of Reservoir, Mark II.*

See also "*Regulations for Care and Preservation of Artillery Matériel.*"

As the reservoirs have to sustain a high pressure when fully charged, it is essential that they should be periodically tested to ascertain if they are in a serviceable condition, and annealed to preserve the tenacity of the material.

The testing will be carried out locally biennially, by pumping in hydraulic pressure up to 3,000 lb. per square inch; any reservoirs failing to pass this test, or showing any permanent set or leakage, must be returned to store for transmission to Woolwich. *Before* and *after* testing, the outside of the reservoir near the centre must be accurately gauged at four points, and the measurements recorded on a history sheet, which is supplied with each reservoir; the date of the biennial test must be stamped on the reservoir.

The reservoirs will be annealed every sixth year, for which purpose they must be returned to store for transmission to Woolwich.

Each reservoir will have a registered number stamped on it, also the manufacturing Mark or name, the numeral of the reservoir, date of issue, and annealing and test marks, with date as under:—

No. 56	The stamping of the date of test on the reservoir must
J. B. and Co.	on no account be done until the pressure has been
II	let out. A history sheet (Army Form G 881) will
1899	be issued with each reservoir. This sheet is intended
(A) 10.3.99	to preserve a complete history of the reservoir from
(T) 11.3.99	the date of issue from the Royal Arsenal to its final

return to store. The biennial tests and re-annealing will be recorded on this sheet, and also anything calling for special remark. The sheet must always be kept with the reservoir, and returned with it to store. Report of the entries made in the sheet are to be sent to the Chief Inspector, Woolwich, through the G.O.C. on the completion of the biennial testing.

Filled reservoirs on R.A. charge should be marked with the word "filled," and with the amount of pressure in them.

Before returning reservoirs to store, they must be first emptied, and the word "empty" stencilled on them.

Reservoirs not on R.A. charge should be stored empty, and so marked.

Care must be taken when removing reservoirs that they are not thrown down or roughly handled. To protect them from jar, three 4-inch tarred rope grumnets will be placed on the reservoirs; and in hot climates, wadmiltits, or such other suitable covering as may be available, will be used, when required, to protect them from the rays of the sun.

---

### SEPARATOR, AIR PUMP, MARK I.

(Plate XXXVI.)

The separator is used to separate the moisture from the air during the process of pumping into the reservoir. It consists of a copper tube,  $1\frac{1}{8}$  inches in diameter and 3 feet long, screwed at both ends. At one end of the copper tube a wrought-iron head (c) is fitted, furnished with inlet and outlet valves of gun-metal, and a  $\frac{1}{4}$ -inch copper pipe (d), which carries the air and water in a downward direction into the separator. At the other end of the copper tube is a wrought-iron foot which is fitted with a drain-cock (e) of gun-metal. The separator is connected up between the pump and the reservoir to be charged, and the moisture of the air, while passing through the copper tube, falls to the bottom and is blown off from time to time during the operation through the drain-cock. When the separator is used, it must be always fixed in a vertical position, the inlet and outlet valves being at the top.

---

### GAUGES, PRESSURE.

(Plate XXXVII.)

The gauges generally consist of a metal cylinder (a) containing the mechanism, which is closed in by a 6-inch dial (b), and a sheet steel plate at the back.

The mechanism consists of a metal bearing which is attached to the cylinder and dial plate; that part of the bearing which is attached to the dial plate is flattened, and suitable bearings are secured to it for the spindle of the dial indicator, and for a crank (c) through which the indicator is actuated, while that part (d) of the bearing which is attached to the side of the cylinder has a channel which is in continuation of the connection (e) (for "Connection, pressure gauge" or "Connection, four-way, air pump"); in one side of this channel is a hole in which one end of a short phosphor bronze tube (f) (No. 4 gauge has steel tubing, owing to the higher pressure it is subjected to) is inserted and soldered, the tube is slightly flexible, and is bent partly round the cylinder, its opposite end being closed with a cap (g), to which is attached a crank arrangement working on a pivot (h), and which has an adjustable arm attached to a segmental rack (i) in gear with a pinion on the spindle of the dial indicator (y).

Each instrument is provided with a dial indicator stop, fixed either on the dial or within against some part of the mechanism.

There are four patterns, and each one is constructed to register the hydraulic pressure per square inch, which together with their respective services are as follows:—

No. 1 (Mark I) from 0 to 350 lb. per square inch:—For carriages, garrison, barbette, B.L. 9·2-inch, Marks IV and V, and 10-inch, Mark IV.

No. 2 (Mark I) for 350 to 1,000 lb. per square inch:—For carriages, garrison, disappearing, B.L. 6-inch, 9·2-inch, and 10-inch (*carriage up*); R.M.L. high angle; also compressed air reservoirs.

No. 3 (Mark I) for 1,000 to 2,200 lb. per square inch:—For carriages, garrison, disappearing, B.L. 6-inch, 9·2-inch, and 10-inch (*carriage down*); also compressed air reservoirs.

No. 4 (Mark I) for 1,800 to 4,500 lb. per square inch:—For pump, testing compressed air reservoirs.

*Action.*—On liquid pressure entering the bent tube within the gauge, it gradually inclines the tube outwards, thus the dial indicator is actuated through the pivoted crank and segmental rack. When the pressure is removed from the instrument, the dial indicator returns to stop at the normal position.

The following steel spanners are used with the above gauges, &c.:—

Spanners—

No. 103, for gauges, pressure, Nos. 1 to 4; also pressure gauge connection.

No. 104, for connection, pressure, gauges, and filling valves disappearing carriages.

## GAUGE, PRESSURE, DEAD WEIGHT TESTING.

### MARK III.

(Plate XXXVIII.)

With this design of gauge "gauges, pressure, Nos. 1 to 4" can be tested, or pressures varying from 0 to 4,000 lb. per square inch. Plungers of varying areas are provided, so that the same set of weights may be made to give four different series (one series for each plunger) of pressures per square inch.

The gauge consists principally of two hollow cylinders directly connected to each other, one vertical (*a*) and the other horizontal (*b*), a ram (*c*), four plungers (*d, e, f, g*), reservoir (*h*), with cover (*s*), carrier (*i*), weights, A to G, intake valve (*l*), and union connection (*m*).

The horizontal cylinder is fitted with a screwed ram which is actuated by a cross handle (*n*), leakage being prevented by a gland with U leather. The hole through the vertical cylinder is of four different diameters to suit the plungers, each one being of twice the area of the one next below. The reservoir surrounds the lower portion of the vertical cylinder (*a*), and the screwed intake valve (*l*) controls the admission of oil from the reservoir to the ram chamber (*k*), and on to the gauge through the hole (*o*).

The four plungers provided are of four different lengths, one for each section of the vertical cylinder, in which it accurately fits; each is coned at the top, and provided with a cross-piece for the attachment of the carrier.

The carrier (*i*) is in the form of a hollow cylinder, open at the bottom and closed at the top by a cap, the interior being coned so as to centre itself on the top of the plunger, and slotted to engage with the cross-piece of the plunger, so that upon the carrier being rotated, the motion may be conveyed to the plunger. The lower portion of the carrier is flanged to receive the weights.

The weights are in the form of discs, each with a central hole to suit the carrier; they consist of the following:—

Weights marked.	No.	Proportional weight.
A	1	1
B	1	2
C	1	3
D	1	4
E	1	10
F	8	20
G	1	15

The arrangements of the weights in size permit of a variation of—  
 $2\frac{1}{2}$  lb. per square inch from  $12\frac{1}{2}$  lb. (weight of carrier and plunger)  
 per sq. in. to 500 lb.

5	"	"	25	"	"	1000	"
10	"	"	50	"	"	2000	"
20	"	"	100	"	"	4000	"

A suitable connection (*m*) is provided for attaching the pressure gauge to be tested, and to permit of the dial facing the operator.

The gauge is secured to a base board suitable for fixing to a bench. A wood cover and two spanners are provided.

#### *Spanners.*

Spanner No. 239 is used for gland, pressure cock, intake valve, and small connecting union.

Spanner No. 240 for union, connecting large, and ram gland.

#### *Instructions for Filling.*

The ram being home, remove the weights, carrier, and plunger, and open the intake valve; pour "oil, lubricating, for cylinders of gas and oil engines," into the vertical cylinder, and withdraw the ram *slowly* (maintaining the supply of oil) until a space of about 9 inches of the ram is visible, continue the supply of oil until it appears in the reservoir and connection for pressure gauge; close intake valve and fill the vertical cylinder, force the ram in to engage with the screwed portion of the horizontal cylinder, and screw in until only a space of  $4\frac{1}{2}$  inches is visible; replace plunger, carrier, and the weights required (see Table).

This operation should be performed *slowly* and carefully, to allow time for the escape of air, as far as possible.

#### *Instructions for Testing.*

When about to screw ram home for pressure, the carrier should be *slowly* rotated, and the motion maintained till the weights are lifted, when the gauge should register the required pressure.

When the ram is screwed home, open intake valve, and *slowly* withdraw ram till a space of  $4\frac{1}{2}$  inches is visible, then close intake valve and proceed as before.

*To clean out.*—Unscrew gland and end plug, remove ram and all packings, and clean with paraffin.

*Contents.*—About half a pint of oil, lubricating, for cylinders of gas and oil engines, is required to charge the gauge.

*Value of weights in lb. per square inch in relation to the plunger used.*

Weights.	Large Plunger.	Large Intermediate Plunger.	Small Intermediate Plunger.	Small Plunger.
A .. .. .	2½	5	10	20
B .. .. .	5	10	20	40
C .. .. .	7½	15	30	60
D .. .. .	10	20	40	80
E .. .. .	25	50	100	200
F .. .. .	50	100	200	400
G .. .. .	37½	75	150	300
x .. .. .	12½	25	50	100

$x =$  lb. per square inch due to carrier and plunger.

Tables showing the arrangement of weights necessary to obtain a given pressure in lbs. per square inch.

Each table is compiled for use with the particular pressure gauge and plunger quoted.

The lbs. pressure per square inch due to the weight of the plunger and carrier (which is represented by  $x$  in the Table) must always be included when calculating the weights.

TABLE 1.—PRESSURE GAUGE NO. 1.

*Plunger: Large.  $x = 12\frac{1}{2}$  lbs. per square inch.*

Weights. lbs. per square inch.													
$x$ 12½	A 2½	B 5	C 7½	D 10	E 25	G 37½	—	F 50	2F 100	3F 150	4F 200	5F 250	6F 300
—	A	—	—	—	—	—	15	65	115	165	215	265	315
—	—	—	C	—	—	—	20	70	120	170	220	270	320
—	—	B	C	—	—	—	25	75	125	175	225	275	325
—	—	—	C	D	—	—	30	80	130	180	230	280	330
—	—	B	C	D	—	—	35	85	135	185	235	285	335
—	A	—	—	—	E	—	40	90	140	190	240	290	340
—	—	—	—	—	E	—	45	95	145	195	245	295	345
—	—	—	—	—	—	G	50	100	150	200	250	300	350
—	—	B	—	—	—	G	55	105	155	205	255	305	—
—	—	—	—	D	—	G	60	110	160	210	260	310	—

TABLE 2.—PRESSURE GAUGE No. 2.

*Plunger: Large, intermediate.  $x=25$  lbs. per square inch.*

Weights. lbs per square inch.													
<i>x</i> 25	A 5	B 10	C 15	D 20	E 50	G 75	— —	3F 300	4F 400	5F 500	6F 600	7F 700	8F 800
—	A	—	—	D	—	—	—	350	450	550	650	750	850
—	A	B	—	D	—	—	—	360	460	560	660	760	860
—	—	B	C	D	—	—	—	370	470	570	670	770	870
—	A	—	—	—	E	—	—	380	480	580	680	780	880
—	A	B	—	—	E	—	—	390	490	590	690	790	890
—	—	—	—	—	—	G	—	400	500	600	700	800	900
—	—	B	—	—	—	G	—	410	510	610	710	810	910
—	—	—	—	D	—	G	—	420	520	620	720	820	920
—	—	B	—	D	—	G	—	430	530	630	730	830	930
—	A	—	C	D	—	G	—	440	540	640	740	840	940
—	—	—	—	—	E	G	—	—	—	—	—	—	950
—	—	B	—	—	E	G	—	—	—	—	—	—	960
—	—	—	—	D	E	G	—	—	—	—	—	—	970
—	—	B	—	D	E	G	—	—	—	—	—	—	980
—	A	—	C	D	E	G	—	—	—	—	—	—	990
—	A	B	C	D	E	G	—	—	—	—	—	—	1000

TABLE 3.—GAUGE PRESSURE No. 3.

*Plunger: Intermediate Small.  $x=50$  lbs. per square inch.*

Weights.											
$x$ 50	A 10	B 20	C 30	D 40	E 100	G 150	4F 800	5F 1000	6F 1200	7F 1400	8F 1600
—	—	—	—	—	—	G	1000	—	—	—	—
—	—	B	C	—	—	G	1050	—	—	—	—
—	—	B	C	—	—	—	—	1100	1300	1500	1700
—	—	—	—	—	E	—	—	1150	1350	1550	1750
—	—	B	C	—	E	—	—	1200	1400	1600	1800
—	—	B	C	—	—	G	—	1250	1450	1650	1850
—	—	—	—	—	E	G	—	—	—	—	1900
—	—	B	C	—	E	G	—	—	—	—	1950
—	A	B	C	D	E	G	—	—	—	—	2000

TABLE 4.—GAUGE PRESSURE No. 3\*.

*Plunger: Small.  $x=100$  lbs. per square inch.*

Weights.										
$x$ 100	A 20	B 40	C 60	D 80	E 200	G 300	2F 800	3F 1200	4F 1600	5F 2000
—	A	—	—	D	—	—	1000	1400	1800	2200
—	—	—	—	—	E	—	1100	1500	1900	—
—	—	—	—	—	—	G	1200	1600	2000	—
—	A	—	—	D	—	G	1300	1700	2100	—

\* Two tables are given for No. 3 Pressure Gauge. Table No. 3 shows a constant variation of 50 lbs. per square inch up to 2,000 lbs., and Table 4 shows a constant variation of 100 lbs. up to 2,200 lbs.

TABLE 5.—GAUGE PRESSURE NO. 4.

*Plunger: Small.  $x=100$  lbs. per square inch.*

Weights.										
$x$ 100	A 20	B 40	C 60	D 80	E 200	G 300	4F 1600	6F 2400	7F 2800	8F 3200
—	—	—	—	—	—	—	—	2500	—	—
—	A	—	—	D	—	—	1800	—	3000	—
—	A	—	—	D	E	—	2000	—	—	—
—	—	—	—	—	E	—	—	—	—	3500
—	A	B	C	D	E	G	—	—	—	4000

*Instructions for using the Tables.*

Having found the number in the table representing the lbs. per square inch required, place the weight or weights shewn at the head of the column (in which the number occurs) on the carrier, together with the weight or weights indicated by the letters on the same line to the left of the table.

*Example.*—Required the necessary weights to indicate 285 lbs. per square inch.

By reference to the Table 1, the following weights are required on the Carrier:—5F + B + C + D +  $x = 5 \times 50 + 5 + 7\frac{1}{2} + 10 + 12\frac{1}{2} = 285$ .

## AMMUNITION.

## CARTRIDGES.

*(Plates XXXIX to XLIV.)*

Nature.		When filled.	
L.S. Guns for which used.	Cartridge.	Length not to exceed	Diameter not to exceed
B.L., 9.2 inch, Marks:—		inches.	inches.
IX .. ..	50-lb. cordite, size 44, $\frac{1}{2}$ charge	33.0	{ 8.25 large end. 6.4 small end.
	25-lb. " " $\frac{1}{4}$ "	16.5	{ 8.25 large end. 6.0 small end.
IX to XV ..	51 lb. 8 oz. cordite, sizes 44 and 37, $\frac{1}{4}$ charge	33.0	{ 8.25 large end. 6.7 small end.
	25 lb. 12 oz. cordite, sizes 44 and 37, $\frac{1}{4}$ charge	16.5	{ 8.25 large end. 5.9 small end.
IX to XV ..	60-lb. Cordite, M.D., size 37, $\frac{1}{4}$ charge	32.5	8.0
	30-lb. cordite, M.D., size 37, $\frac{1}{4}$ charge	16.25	8.0
X to XV ..	54-lb. prism <sup>1</sup> , brown, $\frac{1}{4}$ charge	16.25	10.0
	Aiming rifle, { electric ..	5.0	body base
IX to XV ..	1-in. .. { " blank..	5.0	1.098 1.219



## CARTRIDGE, B.L., 9.2-INCH, 50-LB. CORDITE, SIZE 44.

The 50-lb cordite cartridge is of No. 2 class silk cloth, with ten hoops of 0.65-inch silk braid. It has a lifting becket of 1-inch braid at the small end, and a 1.5-inch wide silk braid lifting becket is stitched to the bag in four places near the primed end. The large end has a silk cord becket which passes through the centre of the cartridge and tied to a silk braid loop, secured to two silk cloth discs in the small end of the cartridge. The charge of cordite is built up, tied with sewing silk and placed in the bag, an annular space being left at one end of each charge for a primer of 8-oz. R.F.G.<sup>2</sup> or new blank F.G. powder, contained in a ring formed by silk cloth and shalloon laid over the end of the charge, and sewn to the bag, the end being entirely covered; the primer is stitched across in four places. The cartridge is closed by silk netting,\* millboard, and silk cloth discs; the silk netting and silk cloth discs are sewn to the bag; the millboard disc has a silk cloth disc attached to it, both being ripped off before loading; a red binding loop, marked "Tear off," being attached for the purpose. The primed end of the cartridge should be placed next to the vent in loading.

No more cartridges of this description will be made.

Packed 1 in a cartridge cylinder.

## CARTRIDGE, B.L., 9.2-INCH, 25-LB. CORDITE, SIZE 44.

This is similar to the 50-lb cartridge, but it has only 5 braid hoops, and not the 1.5-inch extra becket.

No more will be made.

Packed 2 in a cartridge cylinder.

CARTRIDGE, B.L., 9.2-INCH, 51-LB. 8-OZ. CORDITE, SIZES 44 AND 3 $\frac{3}{4}$ .

Mark I: As shown in the plate, this cartridge generally differs from the previous patterns of cordite cartridges in being made of two different sizes of cordite, the smaller size being wound spirally in alternate directions round a central core of cordite, and tied with sewing silk wound in a similar manner. It has 10 hoops of silk braid 0.65-inch wide.

Mark II: The becket is omitted and the number of hoops of 0.65-inch braid reduced to four. The cartridge has a removable lifting band of 1-inch silk braid passed through loops on the side of the bag and tied on top. The cordite is bound round with 0.35-inch silk braid.

Packed 1 in a cartridge cylinder.

CARTRIDGE, B.L., 9.2-INCH, 25-LB. 12-OZ. CORDITE, SIZES 44 AND 3 $\frac{3}{4}$ .

Mark I cartridge is made in a similar way to the  $\frac{1}{2}$  charge of 51-lb. 8-oz. It has 5 braid hoops.

Mark II will be made up similarly to the Mark II  $\frac{1}{2}$  charge, except that it will have no braid hoops.

Packed 2 in a cartridge cylinder.

---

\* The silk netting is now omitted in making up cordite cartridges.

## CARTRIDGE, B.L., 9·2-INCH, 60-LB. CORDITE, M.D., SIZE 37.

Mark I empty cartridge is made of No. 2 class silk cloth, and provided with eight hoops of 0·65 inch silk braid for securing purposes. Three beckets are provided for lifting purposes, two of special braid which are attached to the front of the cartridge, and round the circumference, the braids being 1 inch and  $1\frac{1}{2}$  inch broad respectively; the third becket is of silk cord, secured in the centre of the cartridge.

The charge is built up of M.D. cordite, size 37, cylindrical in shape, with an annular recess at one end to receive a primer of 8-oz. R.F.G.<sup>2</sup> or new blank F.G. powder, contained between a disc of shalloon and one of No. 1 class silk cloth, stitched across the centre so as to form four compartments.

A millboard disc, covered with silk cloth, is placed over the rear or primed end of the cartridge, and is to be torn off before loading in the gun.

Packed 1 in a cartridge cylinder, with a wood packing disc.

## CARTRIDGE, B.L., 9·2-INCH, 30-LB. CORDITE, M.D., SIZE 37.

Mark I. This cartridge of 30-lb. cordite, M.D., size 37, is similar to the 60-lb. ( $\frac{1}{2}$  charge), but being shorter is hooped with four braids only, and is without the  $1\frac{1}{2}$  inch special braid lifting becket near the primed end.

Packed 2 in a cartridge cylinder, as for the 60-lb. cartridge.

CARTRIDGE, B.L., 9·2-INCH, 54-LB. PRISM<sup>1</sup>, BROWN.

Mark I. This cartridge is special for the X and X<sup>v</sup> guns, mounted on Mark V barbette mountings, when firing paper shot.

The empty cartridge is made of No. 3 class silk cloth, with ten 0·65 inch silk braid hoops, and is provided with two beckets at each end for lifting purposes. The charge is built up in 16 tiers (15 tiers of 37 prisms each, and 1 tier of such convenient number as will ensure the correct weight), seven black priming prisms being inserted in each end tier under the silk netting. The cartridge has a circular hole in each end, covered with silk netting, over which a disc of shalloon is shellaced on. The shalloon disc is to be torn off before loading in the gun.

Packed 1 in a cartridge cylinder, with a wood disc.

## CARTRIDGE, B.L., DRILL, 9·2-INCH.

Dummy cartridges are issued for drill purposes.

For Marks IX to X<sup>v</sup> guns, 51-lb. 8-oz., Mark I.

This drill cartridge represents the service cartridge,  $\frac{1}{2}$  charge; it is of wood, weighted with lead in the centre; and is covered with raw hide. A lifting becket of Preller's lace leather is fitted at the small end, and a loop of the same material is fitted at the large end.

SECURING CARTRIDGE CYLINDERS; STACKING, &c.

See "*Regulations for Care and Preservation of War Matériel, Magazines, &c.*"

CARTRIDGES, AIMING-RIFLE, 1-INCH, ELECTRIC.

The Mark II case is of solid drawn brass, having in its base an electric primer made of three tubes, which fit into one another, the central and intermediate ones being insulated from one another by means of goldbeater skin round the body of the former, and a vulcanized fibre washer under its head. A platinum-silver bridge, round which is a tuft of guncotton, connects the ends of the central and intermediate tubes, the space beyond the bridge in the intermediate and outer tubes being filled with fine grain powder. A conical brass plug closes the mouth of the inner tube to prevent the escape of gas. The head of the inner tube is raised in the centre to form a contact point, and round it is a ring of insulating material. The case is charged with 400 grains R.F.G.<sup>2</sup> powder, over which are placed wads, and a pointed bullet of hardened lead, secured to the case as for the percussion cartridge.

Mark IV, M, Mark IV, KN, differ from Mark II in having an electric primer consisting of a brass outer tube, two ebonite insulating plugs, and a brass contact pin. An aradio-platinum wire bridge is soldered, one end to the point of the contact pin, the other end to the circumference of the tube.

In order to facilitate identification of the pattern of primer used in the manufacture of Mark IV cartridges, the letters "M" or "KN" are, in manufacture, stamped on the cartridge and printed on the wrapper after the numeral, to indicate that the primers are made, respectively, to the Morris, or King's Norton Company's pattern.

Mark V<sup>m</sup> differs from Mark IV in having a stronger case with shorter seating for primer, and in the primer hole being screwed and fitted with a screwed primer.

The bullet is partly covered with two turns of fine white paper (certain issues have been made of Mark IV cartridges with this modification).

Packed 96 in a "Box, ammunition, S.A., G.S.," in bundles of 12.

KEY, INSERTING AND REMOVING, PRIMER, CARTRIDGE, AIMING-RIFLE, 1-INCH ELECTRIC, MARK I.

The key is of steel, and is for use in inserting and removing the primer of the Mark V<sup>m</sup> electric cartridge.

CARTRIDGE, AIMING-RIFLE, 1-INCH ELECTRIC, BLANK, MARK I.

The cartridge consists of the service charge, and Mark IV Morris pattern case and primer, the charge being covered by two asbestos disc, which are coated with Pettman cement on the top and edges.

The mouth of the case is turned in.

## PROJECTILES.

(Plates XLV to XLVIII.)

Nature.	Marks.	Bursting charge.		Total weight; filled and fuzed in the case of shell.
		Weight.	Nature.	
Shells, B.L., 9·2-inch— Common—		lb. oz.		lbs.
‡ Iron .. .. {	I, I*, II, II*, VII	18 0	P. and F.G.†	380
‡ Forged steel .. .. {	III, III*	33 0	"	
‡ Cast steel .. .. {	IV, IV*, V, V*	30 6	"	
Lyddite, heavy .. ..	I, II, III	40 0	Lyddite	
Armour-piercing .. ..	I, II, III	18 0	P. and F.G.†	
Armour-piercing, with cap	IV	18 0	"	380
Shrapnel, cast steel ..	VII	2 3	R.F.G. <sup>2</sup>	
Shot, B.L., 9·2-inch— Solid (practice) .. ..	I	..	..	380
Paper, in 4 parts, 3 front and 1 rear .. ..	V	..	..	428 .

To avoid premature explosion through friction when the powder sets back on the shock of discharge, bursting charges of cast-iron common shell are contained in serge or dowlas bags, of forged steel, in serge, of cast steel, in silk cloth or dowlas bags; and of armour-piercing shell, in dowlas bags, or of lasting cloth in future manufacture.

Projectiles not fitted with the gas check driving band, now generally have the front slope of the driving band serrated or roughened to prevent the projectile slipping back when loading the gun at elevation.

SHELL, B.L., COMMON, 9·2-INCH { IRON.  
FORGED STEEL.  
CAST STEEL.

Marks I and II shell are of cast iron, and shorter than those hereafter described; Mark I has the narrow and Mark II the broad driving band, and both have the small base plug covered by the lead disc. An asterisk after the numeral of the shell indicates that they have been fitted with the "driving band with gas-check," as shown in Plate XLV, and a second asterisk indicates that they have been rebanded with gas check, as shown in Plate XLVI. When the groove for driving band is undercut, the iron shell will be known as Mark VII.

No more iron shell will be made, and when the existing stock is used up they will become obsolete.

† In the proportion of 4 lb. P. to 10 oz. F.G. powder.

‡ No more to be made, and as soon as the existing stock is used up, they will become obsolete.

Mark III is of forged steel with a solid base; length, 33.5 inches.

Mark III\* differs from Mark III in having the driving band with gas-check, as in Plate XLV, and when rebanded with the gas check, as shown in Plate XLVI, a second asterisk will be added to the numeral.

Mark IV is of cast steel similar to Mark V, but with a large base plug and no adapter, hence not suitable for a base fuze; the junction of the plug is closed by a lead ring the same as is used for the adapter.

Mark IV\* only differs from the Mark IV in having the driving band with gas check.

Mark V is made of cast steel with bands; its base is rounded with a radius of 0.2 inch. The head is truncated and struck with a radius of two diameters; it has a flanged bush tapped to the G.S. gauge, and provided with the recess for naval wad. The interior is lacquered. There is a hole in the base 1.8 inch in diameter, fitted with a base plug with lead washer under the head. Some shells have, for convenience of manufacture, the hole in the base 2.6 inch diameter which is closed by a gunmetal adapter fitted to take the plug. The use of this adapter is optional with the manufacturer. There is an undercut recess round the flange of the adapter and in the metal of the shell, into which a lead ring is hammered to close the joint, the adapter not being removed for filling the shell. On the exterior of the shell, and in line with the centre of gravity, is a lifting hole tapped for the reception of the eye-bolt used for lifting projectiles. The shell is fitted with a broad Vavasseur driving band having three cannelures.

It is 33.58 inches long, 9.32 inches diameter over driving band, and weighs, filled and fuze, 380 lb.

Mark V\* is the Mark V fitted with driving band with gas check, as in Plate XLV; or, when rebanded, as in Plate XLVI, is indicated by a second star.

No more steel common shell will be made, and as soon as the existing stock is used up they will become obsolete.

#### SHELL, B.L., COMMON, LYDDITE, 9.2-INCH, HEAVY.

Mark I shell is of forged steel, 3.65 calibres long; the base is solid, and rounded to a radius of 0.2 inch; the head is struck with a radius of two diameters, the point being truncated and fitted with a gunmetal bush, which is tapped to G.S. fuze hole gauge. The interior of the shell is varnished.

An undercut groove is turned in the body near the base, into which is pressed the copper driving band with gas check to impart rotation to the shell. The front slope of the gas check portion of the band is serrated or roughened to grip in the bore and to prevent the shell slipping back into the chamber when loading the gun at elevation; the band has two cannelures.

The shell is filled with lyddite, with (in the latest method of filling) 8 to 10 exploders.

The Mark II exploder is made of "Batiste" (water-proof cotton fabric), and contains 7 drams of picric powder. The Mark I exploder differs from the Mark II in being made of oiled silk.

Shells filled between 28.11.04 and 30.5.05 (both dates inclusive) are provided with Mark I exploders, but no more of these exploders will be used in future filling.

Mark II shell differs from Mark I in the form of lower part of driving band, *see* Plate XLVI.

Mark III differs from Mark I in the groove for driving band having waved ribs.

SHELL, B.L., ARMOUR-PIERCING, 9·2-INCH.

Mark I is of forged or cast-steel, the head is brought to a point, and the base is prepared to take the "fuze, percussion, base, large, No. 11." A steel bush may be used in closing the base at the option of the maker; if so, it must be screwed up as tightly as possible and the joint riveted up.

The shell is fitted with the gas check driving band, the groove for it being undercut to prevent the band stripping off.

Mark II differs from Mark I shell in the form of lower part of driving band.

Mark III. In this Mark the groove for driving band has waved ribs; otherwise it is the same as Mark I.

SHELL, B.L., ARMOUR-PIERCING, WITH CAP, 9·2-INCH.

This shell differs from the previous patterns, in being fitted with a cap over the point, and in being stronger in design.

SHELL, B.L., SHRAPNEL, 9·2-INCH.

Mark VII is of cast steel, 3·55 calibres long; radius of head is 2 diameters; the bursting charge is in the base. The head is secured in the usual way, and has a socket of G.S. fuze-hole gauge. The form of driving band is as for the Mark II lyddite shell. The shell is lined with brown paper, and it contains about 638 2-oz. sand shot.

SHOT, SOLID, B.L., 9·2-INCH, MARK I.

This shot is cast solid and fitted with gas check driving band. The ribs in the groove for driving band are waved.

SHOT, PAPER, EMPTY, B.L., 9·2-INCH, FRONT AND REAR.

Mark V is made up in four parts, each consisting of a cylinder of wood pulp, choked at top and bottom to elmwood discs; the bottom disc being weakened by holes partially bored through it so that it may break up on firing.

The total weight of the shot is 428 lb., each portion weighing 107 lb., being filled with "shot waste, 1 to 5," and sawdust; the filling being done through a hole in the top disc, which is then closed by a wood plug.

The cylinders forming a shot are marked "Front" and "Rear," and are used as their names imply. The part marked "Rear" has its bottom disc larger in diameter than the bore, and is in consequence stopped on ramming home, when its rear end reaches the commencement of the bore, in order that the shot may not be rammed home too far.

Marks I to IV were in two parts only, and were made—Mark I of brown paper, Mark II of papier mâché, and Marks III and IV of wood pulp.

Shot of the earlier Marks will be used up, but the number of portions per round will be four, as in the case of Mark V, and each portion will be adjusted to the weight of 107 lbs. by employing a larger quantity of sawdust to waste shot in filling.

The shot are to be fired with powder charges only.

As they break up on firing, the small shot travel but a short distance (about 200 yards), while the effect, for purposes of testing recoil, &c., is practically the same as that obtained with the Service projectile. They will therefore be issued in time of peace, where the use of the Service projectile would be dangerous or inconvenient.

There will, no doubt, be emplacements from which, owing to the close vicinity of houses, it may be undesirable to use these shot in the normal line of fire. In these cases it will often be found possible, owing to the very short range of the paper shot, to find sufficient space to the right or left of the regular range to carry out such test practice as may be required.

See also footnote.\*

#### SHELL, DRILL, B.L., 9·2-INCH.

This is of cast-iron, fitted with two copper bands to prevent injury to the rifling in loading and unloading. The nose is bushed with gunmetal, and the base is fitted with a large hollowed and flanged nut of gunmetal; a gunmetal ring is fitted round the base by being screwed on, a groove is formed between it and the metal of the shell to take a rope grummet, which prevents the shell being rammed too far home. It is weighted up with sand to an average weight of 380 lb. The shell can be extracted from the gun by hooking the shell extractor on the cross bar of base plug.

No more drill shell for the 9·2-inch will be made.

Where 9·2-inch drill shells are not already provided, a service cast-iron common nose-fuzed shell per gun will be set apart for drill purposes, and marked "Drill" in 1-inch white letters round the nose, to ensure the same shell being always used.

Drill shell are rammed home first round only, and local arrangements made for extraction at the conclusion of drill (for this purpose a light spar may be required, *i.e.*, where one can be used).

---

#### EXTRACTORS, DRILL SHELL, Nos. 2 AND 3.

These are of steel, with wood staves (the outer ends being grooved to prevent the hands slipping), the steel portion of each is formed to hook on the cross bar of drill shell base plug.

No. 2: This is of 8 feet total length, for all the marks of gun, except Mark IX on Mark III barbette carriage.

No. 3: This is of 13 feet 4 inches total length, for Mark IX gun on Mark III barbette carriage.

---

\* Mark I shot should not be used unless the range is clear for 1,000 yards; but the other Marks may be used with a range clear up to 400 yards.

*When using these shot the gun should be run up carefully and slowly.*



# FIXING PLUGS AND FUZES, SECURING SHELLS; DISTINGUISHING MARKS, &c.

See "*Regulations for Magazines and the Preservation of Artillery Matériel.*"

## FUZES.

(Plates XLIX to LIII.)

Percussion	base	No. 11.	Marks I*, II*, III, IV, and V.
		No. 15.	Marks I and II.
	large	direct action	
Time	sensitive middle,		No. 24, Mark I.
	and percussion		{ middle, No. 54, Marks I*, II, and III. No. 62, Marks I and II.
Drill	percussion	base, large, No. 11.	
		direct action, with cap, No. 1.	
		direct action impact.	
	time and percussion, middle		{ No. 54. No. 62.

The following is a description of the fuzes :—

### FUZE, PERCUSSION, BASE, LARGE, NO. 11.

(Plate XLIX.)

This fuze is for use in armour-piercing shell.

Some of the earlier Marks of this fuze (Mark II is retained for use with common pointed shell R.M.L., 9-inch, high-angle guns) have been converted to Mark IV design by being fitted with the perforated steel protecting plate, which in this case is screwed into the base of the fuze, and is prevented from turning by three centre punch dabs. When altered a star (\*) is added to the numeral, thus, I\*, II\*.

Mark III (of which only a certain number were made) differs from Mark IV fuze principally in the centrifugal bolt which has less protrusion.

Mark IV consists of the following parts, viz.:—Body, needle, pellet, centrifugal bolt, pressure plate with spindle and nut, perforated protecting plate, screwed cap with detonator and plug, phosphor-bronze spring, brass spring, and four brass screws.

The body of the fuze is of manganese bronze, screwed outside (left hand), to fit the shell. The pressure plate is of copper, and is spun into the base of the fuze; it carries a spindle which retains the centrifugal bolt in the needle pellet by engaging in a slot in the latter until the pressure plate is blown in. The base of the body is recessed to admit of the pressure plate being forced in by the gas pressure when the gun is fired. The protecting plate is of steel and perforated with eight holes to allow the pressure plate to be crushed in; it is spun into the base of the fuze, covering the pressure plate.

The needle pellet is of gunmetal, and has a screwed recess on top for the needle plug, and a hole bored in it, at right angles to the axis, to take the centrifugal bolt, the head of which engages into a recess in the side of the body, and is kept in that position by a spiral brass spring in the opposite side, and by the spindle of the pressure plate. The needle pellet is prevented from working forward in flight by a spiral spring of phosphor bronze.

The detonator is spun into a recess in the screwed cap, and communicates by six fire holes with the magazine containing a compressed pellet of R.F.G.<sup>2</sup> powder, between the cap and the plug.

*Action.*—On discharge, the pressure of the gas crushes in the pressure plate, causing the spindle to release the centrifugal bolt. The rotation of the shell causes the centrifugal bolt to be spun out, compressing the spring in rear, and leaving the needle pellet free to move forward on impact; when the needle strikes the detonator, the flash ignites the powder pellet in the magazine, and explodes the shell.

The head is painted red.

Weight .. .. . 2 lb. 8 oz.

Mark V differs from the previous pattern, externally, in being of greater length over all, having a longer threaded portion on the body, and in the steel protecting plate being screwed in and fixed by four punch dabs; the number of holes in the plate has been reduced to four and their position altered. Internally, it differs in having a different form of pressure plate, the aperture in the body being altered to suit; the detonator is inserted from the outside of the top cap and is held in position by a brass disc, perforated with six fire holes which is secured by turning over the burr on the cap.

*Note.*—Shells fitted with this fuze must never be placed point to base.

#### FUZE, PERCUSSION, BASE, LARGE, No. 15.

This fuze for use with the armour-piercing shell *with cap*, differs from the "fuze, percussion, base, large, No. 11," in having a body of aluminium bronze.

Mark II differs from Mark I in exactly the same details as Fuze, percussion, base, large, No. 11, Mark V, differs from Mark IV, as described above.

#### FUZE, PERCUSSION, DIRECT ACTION, WITH PLUG, No. 3.

(Plate L.)

The Mark III fuze consists of the following principal metal parts, viz.:—Body, safety plug, screw collar, needle disc and steel needle, screw plug for needle disc, and bottom screw plug.

The fuze is made of an alloy resembling gunmetal, with the exception of the steel needle, copper disc, and a few minor portions.

The *body* is threaded throughout on the exterior to the general service taper and pitch, and can be screwed into the shell to admit the naval wad being placed over it. The lower part is hollowed out to receive a blowing charge of 75 grains pistol or R.F.G.<sup>2</sup> powder. The upper portion of the body is bored out to receive the safety plug, screw plug for needle disc, and screw collar; there is a

recess below these to receive the detonating composition, consisting of  $3\frac{1}{2}$  grains of cap composition, varnished, and covered with a brass disc, having on the top of the brass disc a copper washer kept in position by being spun over; this washer has a central hole, which was formerly .2 inch diameter, but from the 192nd thousand it is .3 inch diameter. At the bottom of this recess there are nine conical fire holes, to allow the flash of the detonating composition to pass to the powder; these conical holes are filled with mealed powder paste, and covered on the underside by a disc of fine white paper, and on the upper side by a tin foil disc (subsequent to 27th June, 1894), to prevent the detonating composition working through the powder. The top is closed by the *safety plug*.

The *screw plug for needle disc* is tapped so as to screw into the body and recessed. It is slightly coned at the bottom, and has a hole through the centre. Two holes are drilled in the top so as to screw the plug into the fuze. The *needle disc* is of copper, with the steel needle in the centre; it rests on the screw plug for needle disc.

The *screw collar* screws into the body over the screw plug, having two slots cut in its upper edges for that purpose.

The *needle* is of steel, and of the shape shown in the section, having four points. It is sprung into the needle disc, and the edge is soldered to the latter.

The *bottom plug* has a central hole, closed on the upper side by a disc of paper, and one of shalloon, and two keyholes for screwing it in. It is secured and rendered damp-proof by cement and solder.

The thread of needle screw plug, edge of needle disc, and screw collar are now threaded with Pettman's cement, and the screw collar and needle disc surfaces are finally painted with the same material.

The fuze is prepared by simply removing the safety plug, with the flat end of the key fuze, universal; an arrow on the plug shows the way it is to be turned.

*Action*.—The fuze is at rest in all its parts till direct impact takes place, or a graze at such an angle that the nose of the shell enters the object. When either of these events occurs, the needle is crushed down on to the detonating composition, which fires, and ignites the meal powder in the conical holes and the fine grain powder. The flash therefrom blows down into the shell and fires the charge.

The head of the needle being some distance below the head of the fuze, it cannot be touched or forced down on the detonating composition when any ordinary rammer is used for loading.

Mark IV differs from Mark III fuze in having a removable detonator, a single-pointed needle, and a slightly smaller magazine containing 63 grains of powder.

Weight, 5 ozs. 7 drams.

#### FUZE, PERCUSSION, DIRECT ACTION, IMPACT, No. 13.

*Mark I*.—This fuze is for use with lyddite shell for direct fire. It fits in the nose of the shell; the body is of gun-metal, 2.2 inches long, screwed outside to G.S. gauge, the upper part being turned and furnished with a small projection on each side to receive a cap; the latter was formerly of steel, but now it is made of manganese bronze, with safety pin; the rim of the cap has a T-shaped cut on each side to lock on to the projections on the body, and there is a square key-

hole on the top for fixing the fuze in the shell. The fuze is made waterproof as much as possible, by having a disc of foolscap paper cemented over the head, which is, with all openings made in the body, painted over with Pettman cement.

On the fuze passing through the Ordnance Factories, it has been altered to agree as nearly as possible with Mark III, and then designated Mark I\* and so stamped.

Mark II was designed for R.M.L. high-angle fire lyddite shell.

Mark III: this mark differs from the previous Marks in having additional arrangements in the head, with a view to the exclusion of damp.

Marks I\*, II and III fuzes are brought up to Mark IV pattern, as nearly as possible, when passing through the Ordnance Factories for repair, and when so altered they are stamped thus—I\*\*, II\*, III\*.

Mark IV. is for future manufacture.

Weight of fuze, 10 oz.; weight of cap, 3 oz.

#### SENSITIVE, MIDDLE, No. 24, MARK I.

(Plate LI.)

The fuze consists of the following parts:—

Body, with stem, threaded on the lower part of the outside to G.S. gauge, and containing a blowing charge of M.G.<sup>1</sup> powder, and axial magazine R.F.G.<sup>2</sup> powder; composition ring, with fuze composition having leather and paper washers under it; steel needle; lighting pellet, with detonating composition in cap; two retaining pellets, with spiral springs; dome and nut; two copper safety pins, and bottom plug.

All the metal parts are of gunmetal.

A leather washer is fitted under the shoulder of the fuze closing the joint between the fuze and shell.

The composition ring is graduated on its periphery from 0 to 30, and reads to quarter units. An  $\Psi$  is stamped on the ring to show the safety point, and when this coincides with the  $\Lambda$  on the body, the fuze is set at safety. The cap which screws on to the top of the pillar is made hexagonal, to fit the "key, fuze, universal."

The fuze is set, after being fixed in the shell, by loosening the screw cap on the top of the stem, by means of the "key, fuze, universal," and turning the dome and ring till the required graduation on the collar coincides with the arrow head on the body, and then tightening the screw cap. The safety pins are withdrawn at the moment of loading.

*Action.*—On discharge, the centrifugal action causes the remaining pellets to fly out, releasing the lighting pellet, which flies out by centrifugal force, against the needle, firing the detonator which ignites the powder in the pellet and axial magazine, this latter lighting the quick match in the composition ring.

Time of burning at rest, 14.6 to 15.8 seconds.

Weight, 1 lb. 4 oz.

NOTE.—When the stock shall have been used up, Middle No. 54 or No. 62 fuze will be used.

#### TIME AND PERCUSSION, MIDDLE, No. 54.

(Plate LII.)

The body of Mark III is hollow, with a stem on the upper side. Round the base of the stem an annular groove is cut, from which a hole is bored to the side of the body for the gas to escape. The

sides of the body are pierced with three fire holes; the top of the body is screwed to receive an hexagonal cap. The cap fits the hexagonal hole in the centre of the "key, fuze, universal." Between the cap and the dome fits a brass washer with feathers fitting into slots on the stem of the body; it is to prevent the dome from turning with the nut and altering the setting of the fuze when the cap is screwed tight.

The composition ring has an annular groove round it for the composition, a projection on the upper side contains the hammer with steel needle, suspended by a 0.022-inch wire, and a detonator, under it for lighting the composition in the ring. The hammer is also secured by a safety pin passing under it, the hole in the ring left by its withdrawal being closed by a brass pellet with a spiral spring above it.

The composition ring is barrel-shaped outside to facilitate the setting of the fuze. The ring is kept in position by three projections on the side, which fit closely round the stem of the body. Two escape holes are at the top of the ring at the commencement of the composition, and three radial ones are bored through the inner side at equal distances round it.

The top and first radial holes are covered with paper, the two other radial holes with asbestos. The ring is graduated from 0 to 30, and reads quarter units; the time of burning of the fuze at rest is about 16 seconds; the divisions have four sub-divisions; there is an arrow-head between the last graduation and the commencement, to show the position of safety.

To set the time arrangement of the fuze, the nut is loosened with the "key, fuze, universal," and the ring moved round till the required graduation is opposite the arrow on the body (a black triangular setting mark is now, in manufacture, substituted for the arrow on the body of the fuze); the nut is then tightened, great care being taken to see that it is screwed down as tightly as possible.

The action of the time arrangement is that, on discharge, the hammer sets back, shearing the suspending wire, and fires the detonator, which lights the end of the ring of composition; this burns until the channel communicating with the lower part of the fuze is reached, when the flash passes down it and fires the detonator and magazine in the percussion arrangement.

Mark II differs from Mark III in the latter having a percussion arrangement similar to that in the "time and percussion, fuze, No. 56, Mark IV"; the time ring having no escape holes, except the two at the commencement of the fuze composition; the loops of the eyes of the safety pins are stronger in Mark III, and the time pin is now fitted with a scarlet cord loop.

Mark I has been altered to agree with Mark II, and is now Mark I\*. In future conversion, the fuzes will be fitted with solid wire time safety pins.

Weight .. .. 1 lb. 4 oz.

No more fuzes of this description will be provided, and when the stock is used up, fuze, time and percussion, No. 62 will be used.

*Fuze, Time and Percussion, No. 62 (Mark I).*

(Plate LIII.)

The fuze principally consists of the following parts, which are made of gunmetal, except where otherwise stated: body, detonator

plug with detonator, percussion pellet with needle plug and steel needle, brass safety pellet, brass ball, base plug, time composition rings (upper and lower), brass springs, dome, brass washer, cap, two safety pins, and leather washer.

The *body* is screwed at the lower end to G.S. fuze-hole gauge, and bored from the bottom to receive the percussion pellet and base plug. Two holes are bored beyond the recess for the percussion pellet, one for the detonator plug, the other for the safety pellet. The hole bored for the detonator plug is continued horizontally to form a small magazine which is filled with fine grain powder, the hole then leads upwards, to join the time rings and contains perforated pellet powder. The stem in the body is screwed to take the cap, two featherways being cut in top end of stem to receive corresponding feathers on the brass washer over dome. A small tablet of fine white paper is secured with shellac to the body of the fuze over the perforated powder pellet, and over this tablet are two washers, one of fine white paper and the other of calf skin, which are secured with shellac, a hole being cut through the washers and tablet immediately over the powder pellet; similar tablet, pellet and washers exist on top of the lower time ring.

The *detonator plug* is screwed on the outside to fit the hole prepared for it, and contains a detonator which consists of a copper cap with fire holes, filled with  $3\frac{1}{2}$  grains of detonating composition with a .005-inch brass disc under the composition and a tin foil disc over it, to prevent the composition working through the holes.

The *percussion pellet* has a slot in the side for the safety pellet and brass ball to fall into when set in action. For additional safety a hole is made transversely through the percussion pellet, and fitted with a brass retaining or centrifugal bolt, which engages in the body and is held in position by a brass spiral spring; the outer end being the heavier part of the bolt, it disengages itself from the body in flight. The percussion pellet contains  $5\frac{1}{2}$  grains of powder pellet perforated, having under the latter a muslin disc and brass washer and over it one grain of fine grain powder, and then the needle plug, which is screwed in, the latter is perforated with six fire holes and contains the steel needle. A small set screw in the body fits into a slot in the percussion pellet to prevent the latter turning in flight. Two spiral springs prevent the percussion pellet creeping forward during flight, and causing premature explosion; these springs have a seating in a shallow recess in top of the pellet, and the opposite end in a corresponding recess in the fuze body.

The *safety pellet* has a slot cut in the side to clear the brass ball, and is suspended in the body by a thin copper wire which passes through it. A hole is also bored in the body and upper part of pellet for the percussion safety pin, the hole in the body left by the removal of the safety pin, is closed by a brass pellet, having above it a spiral spring in compression.

The *base plug* contains pellet powder perforated, over the latter are two discs, one paper the other muslin, and a brass washer, and under the pellet a shalloon disc and a brass washer. The base of the fuze is closed by the plug which is made secure by being stabbed in three places.

The *composition rings* have each a channel, which is lined with asbestos paper, for the fuze composition, and a hole is provided which allows the gas direct escape outside; this escape hole is lightly closed by means of a brass disc covered without by Pettman



cement; there are three projections on the inside of the ring to keep it concentric with the body stem.

The upper ring has a chamber which contains a hammer with steel needle, the hammer is suspended by a .022-inch copper wire, a safety pin also passes through the ring and under the hammer, the hole in the ring left by the withdrawal of the pin is closed by a pellet of brass as mentioned above for the percussion safety pin (see safety pellet). Under the needle is detonating composition and mealed powder. The composition channel on the underside and the chamber are connected by a lighting hole, the composition being roughened at the lighting point to assist ignition. The outside of the ring is barrel shaped to facilitate setting, and is graduated from 0 to 30, each division being subdivided into halves and quarters, with an arrow point on bridge portion to mark the position of safety, *i.e.*, when the arrow and both pointers are in the same vertical plane.

The lower ring has a composition channel similar to the upper ring; the ring is flat on the outside and graduated in divisions as before mentioned for the upper ring, but reading from 30 to 60.

Two setting pointers are provided, one of which is fixed to the lower time ring by a screw, and the other to the body under the rings. The pointers are made of cupro-nickel, and blackened.

A pawl is fitted to the lower time ring of the fuze. When the lower part of the pawl is pressed into a slot in the body of the fuze, it prevents the lower time ring from turning while the upper ring is being set. When set at 30, or above, the upper end of the pawl fits into a slot in the upper time ring (in which position it is held by a spring), and locks both rings together.

The dome, brass washer, and hexagonal cap are put on the fuze in the order here given.

The dome is of sheet brass, stamped into shape, and covers the time lighting arrangement.

The washer has two feathers which engage in featherways cut in the stem of fuze; its object is to prevent the dome from turning and altering the setting of the fuze through friction when screwing down the cap.

The cap must be clamped tightly, this is most important, if not done the composition may explode instead of burning. Care must also be taken when clamping not to alter the setting.

The fuze is stamped **T** on the upper composition ring close to the time safety pin, and **P** on the body close to the percussion safety pin. The pins are each provided with a whipcord becket or loop, the **T** one being scarlet, and that of **P** tarred.

The openings in the fuze are coated with Pettman cement to exclude damp.

A leather washer in a groove above the fuz-hole thread makes a tight joint.

The fuze should be set *before* the safety pins are withdrawn.

To set the time arrangement, the cap is loosened with the "key, fuze, universal," and the ring moved round until the graduation ordered and the pointer coincide; the fuze is then clamped by screwing down the cap as tightly as possible, care being taken that the ring and dome have even bearings, and the setting has not shifted.

If the fuze is required to act as a percussion fuze only, the **P** pin should be withdrawn, and the **T** pin left in position; otherwise, both pins should be withdrawn, but this should not be done till the moment of loading.



*Action.*—On discharge, if the time safety pin has been withdrawn, the hammer sets back, shearing the suspending wire, and igniting the detonator and the time ring, which burns until it comes over the pellet and so flashes down through the radial magazine, percussion detonator pellet, and base plug and into the shell.

If the percussion pin has been withdrawn, the safety pellet sets back, shearing the suspending wire, and the brass ball falls down into the space over the safety pellet. The centrifugal bolt, owing to the rotation of the shell, is withdrawn, the percussion pellet is free to move forward on impact and ignite the detonator, which flashes through the percussion pellet and base plug into the shell.

The time of burning at rest is about 35 seconds.

Weight of fuze (about) 1 lb. 7 oz.

Mark II differs in the following particulars:—

- (1) The dome is thicker.
- (2) The stem of the body is thicker and slightly longer.
- (3) There is only one setting pointer, which is fixed to the lower time ring.
- (4) The lower time ring is milled.
- (5) The graduations are on the upper time ring only.
- (6) The fuze is heavier, the average weight being 1 lb. 9 $\frac{3}{4}$  oz.

## DRILL FUZES.

### FUZE, DRILL, PERCUSSION, BASE, LARGE, No. 11.

Service fuzes which have been burnt out will, as far as possible, be utilized for this purpose, by being cleaned and refitted with empty screwed cap and plug, bronzed and stamped DRILL.

### FUZE, DRILL, PERCUSSION, D.A. WITH CAP, No. 1.

This drill fuze is made of gunmetal, solid, and to the same external dimensions as the service fuze. The body and cap are bronzed, and stamped DRILL.

### FUZE, DRILL, PERCUSSION, D.A. IMPACT.

This drill fuze is generally similar in external appearance to the service fuze. It consists of a hollow body, removable cap, and steel split safety pin, which can be withdrawn and replaced as required; it is intended for use with the drill lyddite shell. The fuze is bronzed and stamped DRILL.

### FUZE, DRILL, T. AND P. MIDDLE, No. 54.

This drill fuze resembles the Service pattern, but is issued empty, and provided with special safety pins which can be withdrawn and replaced as required. A steel washer is fitted under the cap. The dome and cap are bronzed to facilitate identification. The fuze is stamped DRILL.

### FUZE, DRILL, T. AND P., No. 62.

This drill fuze resembles the Service pattern, but is issued empty, and provided with special safety pins which can be withdrawn and replaced as required. The dome and cap are bronzed to facilitate identification. The fuze is stamped DRILL.

## TUBES.

(Plates LIV to LVII.)

Tubes	{	Electric, wireless P., Marks I to IV.
Vent		Percussion, Marks II to VI.
Sealing.		Percussion, drill, Marks I and II.

Primer, vent, cordite, Mark I.

The percussion lock arrangement necessitates a special tube for firing the charge, and this tube performs a double duty in sealing the vent when fired so as to prevent the escape of gas. The tubes, for service are made of two patterns for firing by hand or by electricity.

## TUBE, VENT-SEALING, ELECTRIC, WIRELESS, P.

(Plate LIV.)

Mark I consists of a body, conical brass plug, copper pole, cork plug, ebonite cup, ebonite plug, hollow ebonite cone, insulated copper wire, two paper discs, and two platinum-silver wires.

The body is made of brass, with a recess in the head to receive an ebonite cup which (since 1st February, 1899) is screwed into the head of the tube, and into which fits a white-metal contact piece, secured by an undercut groove in the ebonite, and connected by an insulated copper wire with the interior of the tube; a hole is bored through the head of the tube for the copper wire to pass through. The lower end of the insulated wire is attached to the brass conical plug, which is insulated from the body of the tube by the hollow ebonite cone. The large end of the brass plug is cupped-out to form a gas-check, and has a centre hole bored and screwed to receive an ebonite plug. Into this ebonite plug is fixed the copper pole, which consists of a copper wire, coated with pure tin, one end fitting into the ebonite plug, the other being secured to the side of the tube.

The copper pole and conical brass plug are connected by a double bridge of platinum-silver wire. The space round the bridge and pole is charged with 2 grains of composition priming, over which is placed a white paper disc.

The tube is filled with about 24 grains of pistol powder (in present manufacture a special fine grained powder is used), and the end is closed by a disc of white paper and a cork plug shellaced in.

*Action.*—On contact being made the current passes through the striker, short wire, cone, double bridge, long copper pole, and the body of the tube. The double bridge becomes incandescent, which fires the priming and powder, the gas expands the cupped-out plug and prevents the escape of gas through the head, the current passing back to the battery again through the metal of the tube and gun.

Mark II differs from Mark I in having a single instead of a double bridge, and in a few slight manufacturing details; the conical plug is somewhat larger in diameter, the contact disc is of pure tin in present manufacture, instead of white-metal as previously; tubes having the pure tin contact disc will be distinguished by the letter "T" stamped on the head; two paper discs are used in closing the tube, one on either side of the cork plug. This mark has now the edge of the ebonite cup bevelled off as mentioned for Mark III tube.

Mark III has a contact disc and ebonite cup of slightly larger diameters, and the ebonite cup bevelled off flush with the contact disc, otherwise the tube is the same as Mark II.

Mark IV differs from the Mark III principally in having a perforated glazed board disc (with paper disc attached) between the priming composition and the pellet powder, the bridge is made of iridio-platinum "wire, electric, uncovered, L 13," and in latest manufacture the end of the tube is burred to secure the cork plug.

The tubes are packed 10 in a tin box.

#### TUBE, VENT-SEALING, PERCUSSION.\*

(Plates LV and LVI.)

Mark II tube differs from Mark IV in not having the diagonal fire holes in the anvil.

Mark III is the same as Mark IV, except that the bottom of the tube is closed with a paper disc and perforated brass ball, embedded in sulphur and secured with shellac. *It must not be used unless the range is clear. See Notes, page 86.*

Mark IV.—This consists of a body, anvil, striker, brass washer, percussion cap, copper washer, two paper discs, and a cork plug. The body is made of brass, solid drawn; a hole is drilled through the head to receive the striker, which is secured in position by being riveted into the countersunk washer, as shown in the Plate. The upper part of the chamber is screwed and fitted with an anvil, on which is placed the percussion cap, the upper surface of which is in contact with the striker; a small central and two diagonal fire holes are drilled through the anvil. The remainder of the space in the tube is filled with loose pistol powder, and the bottom is closed with a paper disc and cork plug coated with varnish.

*Action.*—This is the same as Mark VI tube, excepting that the striker of the tube, together with the percussion cap, is driven on to the anvil, thus firing the tube.

Mark V tube differs from Mark VI in the form of the striker, which is without the cup-shaped gas-check and the detonator, which is held in position by a brass screwed collar. The tube is filled with R.L.G.<sup>2</sup> powder, the interstices being filled up with R.F.G.<sup>2</sup> powder, but in latest manufacture a special fine grain powder (those filled on or before 14th December, 1899, were filled with pistol powder); it is closed with a paper disc and cork plug coated with varnish. This mark will be used up for drill and instructional purposes only.

Mark V. tube consists of a body, striker, detonator, detonator holder, two washers, shearing wires, two paper discs, and cork plug.

The body is of solid drawn brass, the head is bored centrally for the striker, detonator and fire channel. The striker is of brass, with a needle point and a plain flange at its base, under which is fitted a copper, cup-shaped gas-check, and it is held in position by a copper shearing wire passed through the tube and a brass washer in the recessed head of the tube. The detonator is fitted into the holder, and the latter is screwed into the body of the tube. Under the detonator holder is a copper washer and a disc of fine white paper. The lower part of the tube is filled with R.F.G.<sup>2</sup> powder siftings, or else a special fine grain powder (present manufacture). The tube is closed with a paper disc and cork plug, which is coated with varnish.

\* Percussion V.S. tubes of present manufacture are blacked, and have four notches cut in the rim of the head to distinguish them from wireless electric tubes by sight or touch. Previous issues of V.S. percussion tubes will be similarly dealt with on passing through the O.F. for any conversion. This will not necessitate any change in numeral.

*Action.*—On firing the gun the point of the striker of the percussion lock drives the striker of the tube on to the detonator, thus firing the tube, the flash passing on to the charge.

Packed 10 in a tin box.

#### TUBE, VENT-SEALING, PERCUSSION, DRILL.

(Plate LVII.)

Mark I.—This tube is of gunmetal, the interior being bored out and the head fitted to receive the coned india-rubber plug. The lower portion is closed by a gunmetal plug.

Mark II differs from Mark I in being made to the same dimensions as the service tube, in having four longitudinal grooves on the body 1.4 inch long, in the rim of the head being milled, in the diameter of recess in head being .25-inch instead of .2-inch, and in the body being blacked all over.

#### PRIMER, VENT, CORDITE.

This consists of a stick of cordite, size 20, cut 4.75 inches long. It is for use with powder charges and vent-sealing tubes without ball, and is put in the vent after the breech is closed and before the tube is inserted.

Packed 10 in a box.

---

#### NOTES.

In the event of a tube failing to ignite the charge, care should be taken in extracting the fired tube not to stand directly in rear of the gun, as the gas generated will cause the tube to fly out with some violence when eased by the extractor.

The vent sometimes becomes choked with residue from the cartridge. It should be cleared with a "rimer vent axial" sufficiently to allow of the insertion of a tube, which, when fired, will remove the rest of the obstruction.

Care must be taken to see that the range is clear when using vent-sealing tubes with ball (Mark III, percussion) for clearing the vent, or any other purpose than regular practice (in which case the range would, of course, be clear before firing), as the brass ball is projected with considerable velocity by the powder in the tube.

---

## RANGE TABLE for 9.2-inch B.L. Gun, Mark IX (full charge).

Based on Practice of 11 and 13. 7. 98.

Minute 45,700.  $\frac{40185}{9552}$ 

Charge { weight, 100 lb.  
gravimetric density,  $\frac{81.0}{0.342}$   
nature, cordite, size 44.

Muzzle velocity, 2,601 f.s.

Nature of mounting, barbette, Mark III.

Projectile { nature, common shell, pointed,  
Mark II.  
weight, 379 lb.

Jump,  $7\frac{1}{2}$  minutes, negative.

Corrected for gun on same level as target.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or depression alters point of impact		ELEVATION.	RANGE.	Fuze scale for time and percussion middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.		
f.s.	yards.	° ' "	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	seconds.	inches.
2571	2833	0 3	250	0.14	0 10	100	0	19.8	0.10	0.08	0.12	32.0
2542	950	0 6	166	0.29	0 13	200	0	20.0	0.13	0.09	0.24	31.5
2513	635	0 9	164	0.43	0 16	300	1	20.01	0.16	0.11	0.36	31.0
2485	477	0 12	162	0.58	0 19	400	1	20.03	0.18	0.14	0.48	30.5
2457	381	0 15	160	0.72	0 21	500	1	20.04	0.21	0.15	0.60	30.0
2431	317	0 18	158	0.87	0 23	600	1	20.05	0.25	0.16	0.72	29.5
2404	285	0 21	156	1.01	0 26	700	2	20.07	0.28	0.18	0.84	29.0
2376	245	0 24	154	1.16	0 29	800	2	20.08	0.31	0.20	0.96	28.5
2350	207	0 27	152	1.31	0 31	900	2	20.09	0.35	0.21	1.09	28.0
2325	178	0 31	150	1.45	0 34	1000	2	21.1	0.38	0.24	1.22	27.5
2300	160	0 34	148	1.60	0 37	1100	3	21.3	0.40	0.25	1.34	27.0
2274	145	0 38	146	1.74	0 40	1200	3	21.4	0.43	0.27	1.47	26.6
2250	133	0 41	144	1.89	0 43	1300	4	21.6	0.47	0.29	1.60	26.2
2226	122	0 45	143	2.03	0 46	1400	4	21.7	0.50	0.31	1.73	25.8
2203	113	0 48	141	2.18	0 49	1500	4	21.8	0.54	0.34	1.86	25.4
2180	106	0 52	139	2.32	0 52	1600	5	22.0	0.57	0.37	2.00	25.0
2157	100	0 55	138	2.47	0 55	1700	5	22.2	0.59	0.39	2.14	24.6
2135	93	0 59	137	2.61	0 58	1800	5	22.4	0.61	0.41	2.28	24.2
2115	88	1 2	135	2.76	1 1	1900	6	22.5	0.63	0.43	2.41	23.8
2095	83	1 6	133	2.91	1 4	2000	6	22.6	0.66	0.45	2.55	23.5
2075	80	1 9	131	3.05	1 7	2100	6	22.8	0.69	0.50	2.69	23.2
2055	77	1 13	129	3.20	1 11	2200	7	23.0	0.71	0.52	2.83	22.8
2036	75	1 16	128	3.34	1 14	2300	7	23.2	0.74	0.55	2.98	22.5
2017	72	1 20	127	3.49	1 17	2400	8	23.4	0.77	0.58	3.13	22.2
1998	68	1 24	125	3.63	1 21	2500	8	23.6	0.80	0.61	3.28	21.9
1980	65	1 28	124	3.78	1 25	2600	8	23.8	0.83	0.64	3.43	21.6
1963	61	1 32	123	3.92	1 28	2700	9	24.0	0.85	0.68	3.58	21.3
1945	60	1 36	123	4.07	1 31	2800	9	24.3	0.88	0.71	3.73	21.0
1928	58	1 40	122	4.21	1 35	2900	9	24.5	0.90	0.74	3.88	20.7
1911	55	1 44	121	4.36	1 38	3000	10	24.8	0.92	0.78	4.03	20.5
1896	53	1 48	120	4.51	1 41	3100	10	25.0	0.94	0.81	4.18	20.2
1881	50	1 53	119	4.65	1 45	3200	11	25.2	0.97	0.85	4.34	20.0
1865	48	1 57	118	4.80	1 49	3300	11	25.5	1.00	0.89	4.50	19.7
1850	47	2 2	117	4.94	1 53	3400	11	25.7	1.03	0.93	4.66	19.5
1835	45	2 6	116	5.09	1 56	3500	12	26.0	1.05	0.98	4.82	19.3
1820	43	2 11	115	5.23	2 0	3600	12	26.2	1.08	1.02	4.98	19.1
1805	41	2 16	114	5.38	2 4	3700	13	26.5	1.10	1.07	5.14	18.8
1792	40	2 21	113	5.52	2 8	3800	13	26.8	1.13	1.12	5.30	18.6
1778	38	2 26	112	5.67	2 12	3900	13	27.0	1.17	1.17	5.46	18.4
1764	37	2 31	111	5.81	2 16	4000	14	27.3	1.20	1.22	5.62	18.2
1750	35	2 36	111	5.96	2 19	4100	14	27.7	1.23	1.26	5.87	18.0
1737	33	2 41	110	6.11	2 23	4200	15	27.9	1.26	1.31	5.93	17.8
1724	33	2 46	110	6.25	2 27	4300	15	28.2	1.27	1.38	6.10	17.6
1712	31	2 51	109	6.40	2 31	4400	16	28.5	1.30	1.44	6.27	17.4
1699	31	2 56	108	6.54	2 35	4500	16	28.8	1.33	1.52	6.44	17.2

RANGE TABLE for 9.2-inch B.L. Gun, Mark IX—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or depression alters point of impact		ELEVATION.	RANGE.	Fuzes scale for time and percussion middle, No. 64, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of sight.	Penetration into wrought iron.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.		
f.s.	yards.	° ' "	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	seconds.	inches.
1685	30	3 12	108	6.69	2 39	4600	167	29.2	1.36	1.58	6.60	17.0
1672	28	3 8	107	6.83	2 43	4700	177	29.5	1.40	1.65	6.77	16.8
1658	28	3 14	107	6.98	2 47	4800	177	29.8	1.43	1.73	6.94	16.6
1644	27	3 20	106	7.13	2 51	4900	187	30.1	1.47	1.81	7.10	16.4
1631	26	3 26	105	7.27	2 55	5000	187	30.4	1.50	1.90	7.27	16.2
1618	25	3 32	104	7.42	2 59	5100	19	30.8	1.54	2.00	7.45	16.1
1606	25	3 39	103	7.56	3 4	5200	19	31.1	1.58	2.08	7.63	15.9
1594	24	3 45	102	7.71	3 8	5300	20	31.5	1.62	2.18	7.81	15.7
1581	23	3 52	101	7.85	3 12	5400	20	31.8	1.66	2.29	7.99	15.5
1568	23	3 59	100	8.00	3 17	5500	21	32.2	1.70	2.39	8.17	15.3
1555	22	4 6	99	8.14	3 21	5600	21	32.6	1.74	2.50	8.36	15.2
1542	22	4 13	98	8.29	3 26	5700	22	33.0	1.77	2.62	8.54	15.0
1529	21	4 21	97	8.43	3 30	5800	22	33.4	1.80	2.74	8.72	14.9
1517	20	4 29	96	8.58	3 34	5900	23	33.8	1.84	2.86	8.90	14.8
1504	20	4 37	95	8.73	3 39	6000	23	34.2	1.88	2.99	9.09	14.6
1492	20	4 45	93	8.87	3 44	6100	24	34.6	1.92	3.10	9.27	14.5
1480	20	4 54	92	9.01	3 49	6200	24	35.0	1.96	3.23	9.46	14.4
1467	19	5 2	91	9.16	3 53	6300	25	35.4	2.01	3.37	9.65	14.2
1455	18	5 11	90	9.30	3 58	6400	25	35.8	2.05	3.52	9.85	14.1
1444	17	5 20	89	9.45	4 4	6500	26	36.3	2.09	3.68	10.05	14.0
1432	17	5 29	88	9.60	4 10	6600	26	36.6	2.13	3.83	10.26	13.8
1419	16	5 39	87	9.74	4 15	6700	27	37.1	2.17	4.00	10.47	13.7
1407	16	5 49	86	9.89	4 20	6800	27	37.6	2.21	4.16	10.68	13.6
1395	16	5 59	85	10.03	4 25	6900	28	38.0	2.25	4.34	10.88	13.5
1384	15	6 10	84	10.18	4 30	7000	28	38.4	2.30	4.60	11.09	13.4
1373	15	6 21	83	10.32	4 36	7100	29	38.8	2.34	4.70	11.30	13.3
1362	15	6 32	82	10.46	4 42	7200	29	39.3	2.38	4.89	11.51	13.2
1352	15	6 43	81	10.60	4 47	7300	30	39.6	2.42	5.08	11.72	13.0
1340	15	6 55	80	10.75	4 53	7400	...	40.1	2.46	5.28	11.94	12.9
1330	14	7 7	79	10.89	4 59	7500	...	40.7	2.51	5.47	12.16	12.8
1320	14	7 19	78	11.04	5 5	7600	...	41.2	2.55	5.68	12.39	12.7
1309	13	7 31	77	11.19	5 11	7700	...	41.7	2.59	5.90	12.63	12.6
1298	11	7 44	76	11.34	5 18	7800	...	42.2	2.63	6.14	12.86	12.5
1288	11	7 57	75	11.48	5 24	7900	...	42.7	2.66	6.38	13.10	12.4
1279	11	8 10	74	11.63	5 30	8000	...	43.2	2.70	6.62	13.33	12.3
1270	11	8 23	73	11.77	5 37	8100	...	43.7	2.74	6.89	13.58	12.2
1260	11	8 37	72	11.92	5 43	8200	...	44.3	2.78	7.16	13.83	12.1
1250	11	8 51	71	12.07	5 49	8300	...	44.8	2.82	7.43	14.07	12.0
1242	10	9 5	71	12.22	5 56	8400	...	45.4	2.86	7.71	14.32	11.9
1233	10	9 20	70	12.36	6 4	8500	...	45.9	2.90	8.00	14.57	11.8
1223	10	9 35	70	12.51	6 11	8600	...	46.5	2.95	8.30	14.82	11.7
1213	10	9 50	69	12.65	6 18	8700	...	47.0	3.00	8.62	15.07	11.6
1204	10	10 6	68	12.80	6 25	8800	...	47.6	3.05	8.94	15.32	11.5
1194	9	10 22	67	12.94	6 32	8900	...	48.2	3.11	9.27	15.57	11.4
1185	9	10 38	67	13.09	6 39	9000	...	48.8	3.17	9.62	15.82	11.3
1176	9	10 54	66	13.24	6 46	9100	...	49.3	3.23	9.95	16.07	11.2
1167	8	11 11	65	13.38	6 54	9200	...	49.8	3.30	10.30	16.32	11.1
1159	8	11 28	64	13.53	7 1	9300	...	50.4	3.37	10.68	16.58	11.1
1150	8	11 45	64	13.67	7 9	9400	...	51.0	3.44	11.05	16.84	11.0
1142	8	12 2	63	13.81	7 17	9500	...	51.6	3.52	11.44	17.10	11.0
1134	8	12 20	63	13.96	7 24	9600	...	52.2	3.61	11.84	17.37	10.9
1126	7	12 38	62	14.11	7 32	9700	...	52.8	3.70	12.23	17.64	10.8
1118	7	12 56	61	14.26	7 40	9800	...	53.3	3.79	12.63	17.90	10.7
1110	7	13 14	60	14.40	7 48	9900	...	53.9	3.89	13.05	18.17	10.6
1102	7	13 32	59	14.55	7 56	10000	...	54.5	4.00	13.45	18.45	10.4
1096	7	13 50	58	14.69	8 5	10100	...	55.0	4.10	13.87	18.73	10.4
1089	7	14 9	57	14.84	8 14	10200	...	55.6	4.22	14.28	19.00	10.3
1082	7	14 27	56	14.98	8 22	10300	...	56.2	4.34	14.70	19.28	10.2
1075	6	14 46	55	15.13	8 31	10400	...	56.8	4.46	15.12	19.57	10.2
1069	6	15 5	55	15.27	8 40	10500	...	57.3	4.58	15.55	19.87	10.1

RANGE TABLE for 9.2-inch B.L. Gun, Mark IX—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or depression alters point of impact.		ELEVATION.	RANGE.	Fuze scale for time and percussion middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.		
f.s.	yards.	° /	yards.	yards.	° /	yards.	...	yards.	yards.	yards.	seconds.	inches.
1063	6	15 24	54	15.42	8 49	10600	...	58.0	4.70	16.00	20.17	10.0
1057	6	15 44	53	15.56	8 58	10700	...	58.6	4.83	16.43	20.46	10.0
1051	6	16 4	53	15.71	9 8	10800	...	59.2	4.97	16.37	20.75	9.9
1045	5	16 24	52	15.86	9 17	10900	...	59.8	5.12	17.32	21.04	9.8
1039	5	16 45	51	16.00	9 26	11000	...	60.3	5.27	17.77	21.34	9.8
1034	5	17 6	50	16.15	9 36	11100	...	60.8	5.42	18.24	21.65	9.7
1029	5	17 27	49	16.29	9 46	11200	...	61.5	5.58	18.70	21.96	9.7
1024	5	17 48	48	16.43	9 55	11300	...	62.2	5.76	19.27	22.27	9.6
1019	5	18 10	47	16.58	10 5	11400	...	62.8	5.92	19.63	22.59	9.6
1014	5	18 32	45	16.73	10 16	11500	...	63.4	6.10	20.13	22.90	9.5
1009	5	18 54	45	16.88	10 25	11600	...	64.0	6.27	20.60	23.21	9.5
1004	5	19 16	44	17.02	10 36	11700	...	64.6	6.45	21.07	23.52	9.4
1000	5	19 39	44	17.17	10 46	11800	...	65.2	6.64	21.57	23.83	9.3
995	4	20 2	44	17.31	10 57	11900	...	65.8	6.83	22.07	24.14	9.3
990	4	20 25	43	17.46	11 8	12000	...	66.5	7.03	22.57	24.44	9.2
986	4	20 48	43	17.60	11 19	12100	...	67.1	7.23	23.08	24.75	9.2
981	4	21 12	43	17.75	11 30	12200	...	67.7	7.42	23.57	25.06	9.2
977	4	21 36	42	17.90	11 41	12300	...	68.3	7.62	24.06	25.37	9.1
973	4	22 1	42	18.04	11 53	12400	...	69.0	7.83	24.56	25.69	9.0
969	4	22 26	41	18.18	12 5	12500	...	69.6	8.05	25.09	26.00	9.0
965	4	22 51	40	18.33	12 16	12600	...	70.2	8.26	25.60	26.31	8.9
961	4	23 16	39	18.47	12 28	12700	...	70.8	8.50	26.13	26.63	8.9
957	4	23 42	38	18.62	12 41	12800	...	71.5	8.74	26.65	26.95	8.8
953	3	24 8	38	18.76	12 54	12900	...	72.0	9.00	27.18	27.27	8.8
949	3	24 34	37	18.90	13 7	13000	...	72.6	9.25	27.70	27.59	8.7
946	3	25 0	37	19.05	13 20	13100	...	73.3	9.50	28.20	27.91	8.7
943	3	25 27	36	19.20	13 33	13200	...	73.8	9.75	28.50	28.23	8.7
939	3	25 54	36	19.34	13 46	13300	...	74.5	10.00	29.27	28.55	8.6
936	3	26 21	35	19.49	14 00	13400	...	75.1	10.28	29.80	28.87	8.6
933	3	26 48	35	19.63	14 14	13500	...	75.7	10.55	30.37	29.18	8.5
929	3	27 16	35	19.78	14 28	13600	...	76.4	10.82	30.90	29.50	8.5
924	3	27 44	34	19.93	14 42	13700	...	77.1	11.12	31.45	29.84	8.4
919	3	28 12	34	20.07	14 56	13800	...	77.7	11.40	32.00	30.20	8.4

The proportional resistance to penetration of wrought-iron, compound or mild steel, and Harveyed armour, may be taken roughly as 1 : 1½ : 2.

A 9.2-inch common shell, with a velocity of about 2,000 f.s., may be expected to perforate about 6 inches of Harveyed armour, if struck direct; or about 5 inches at 30° to the normal.

Under similar circumstances, a 9.2-inch armour-piercing shell may be expected to perforate about 9 inches and 7 inches Harveyed armour, and it would probably perforate 9 inches of compound or mild steel armour if struck direct or at an angle of 30° to the normal.



## RANGE TABLE for 9.2-inch B.L. Gun, Mark IX (three-quarter charge).

Based on Practice of 5.12.98.

Minute 46,518 III.  $\frac{40185}{9552}$ 

Charge	weight, 75 lb.	Muzzle velocity, 2127 f.s.
	gravimetric density, $\frac{108.0}{0.257}$ .	Nature of mounting, barbette, Mark III.
Projectile	nature, cordite, size 44.	
	nature, common shell, filled.	Jump, $7\frac{1}{2}$ minutes, negative.
	weight, 380 lb.	

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact		ELEVATION.	RANGE.	Fuze scale for fuze T. and P. middle No. 54 Marks I, II, or III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.	
f.s.	yards.	° /	yards.	yards.	° /	yards.		yards.	yards.	yards.	secs.
2111	955	0 4	125	0.14	0 10	100		...	...	...	0.14
2090	520	0 9	125	0.29	0 14	200		...	...	...	0.28
2068	358	0 13	124	0.43	0 18	300	1	...	...	...	0.42
2046	273	0 18	123	0.58	0 22	400	1	...	...	...	0.56
2026	228	0 22	122	0.72	0 26	500	2	...	...	...	0.71
2006	191	0 27	121	0.87	0 30	600	2	9	0.5	0.08	0.86
1986	163	0 31	120	1.01	0 34	700	2	10	0.5	0.10	1.01
1966	143	0 36	119	1.16	0 38	800	3	11	0.6	0.11	1.16
1948	127	0 41	118	1.31	0 42	900	3	11	0.6	0.14	1.31
1930	115	0 46	117	1.45	0 46	1000	4	12	0.6	0.17	1.47
1911	103	0 51	116	1.60	0 50	1100	4	12	0.7	0.20	1.63
1893	95	0 56	115	1.74	0 54	1200	4	13	0.7	0.22	1.80
1875	87	1 1	113	1.89	0 58	1300	5	13	0.7	0.25	1.97
1857	80	1 6	112	2.03	1 2	1400	5	14	0.8	0.29	2.14
1841	75	1 11	110	2.18	1 6	1500	6	14	0.8	0.32	2.31
1825	70	1 17	109	2.32	1 10	1600	6	15	0.8	0.36	2.48
1809	65	1 22	107	2.47	1 14	1700	6	16	0.9	0.40	2.65
1793	61	1 28	106	2.61	1 18	1800	7	17	0.9	0.44	2.82
1777	59	1 33	104	2.76	1 22	1900	7	18	0.9	0.50	2.98
1761	55	1 39	102	2.91	1 26	2000	8	19	0.9	0.57	3.15
1746	51	1 45	100	3.05	1 30	2100	8	19	1.0	0.63	3.32
1731	48	1 51	99	3.20	1 35	2200	8	20	1.0	0.69	3.50
1716	45	1 57	98	3.34	1 40	2300	9	21	1.1	0.75	3.67
1702	43	2 4	96	3.49	1 45	2400	9	21	1.1	0.81	3.85
1687	41	2 11	95	3.63	1 50	2500	10	22	1.1	0.88	4.02
1672	40	2 18	93	3.78	1 56	2600	10	23	1.2	0.95	4.19
1658	38	2 25	92	3.92	2 1	2700	11	23	1.2	1.02	4.37
1645	37	2 32	91	4.07	2 7	2800	11	24	1.2	1.10	4.55
1631	35	2 39	90	4.21	2 12	2900	11	24	1.3	1.17	4.73
1617	33	2 47	89	4.36	2 18	3000	12	25	1.3	1.25	4.92
1603	31	2 54	87	4.51	2 23	3100	12	25	1.3	1.28	5.11
1590	31	3 2	86	4.65	2 28	3200	13	26	1.4	1.30	5.30
1576	30	3 9	85	4.80	2 33	3300	13	27	1.4	1.45	5.48
1563	28	3 17	83	4.94	2 38	3400	14	28	1.4	1.60	5.66
1550	27	3 25	82	5.09	2 43	3500	14	28	1.4	1.70	5.85
1537	27	3 33	81	5.23	2 49	3600	15	29	1.5	1.80	6.05
1524	26	3 41	80	5.38	2 54	3700	15	29	1.5	1.90	6.24
1511	25	3 50	78	5.52	3 0	3800	16	30	1.5	2.0	6.44
1499	25	3 58	77	5.67	3 6	3900	16	30	1.6	2.1	6.64
1487	24	4 7	76	5.81	3 12	4000	17	31	1.6	2.2	6.85
1475	23	4 16	75	5.96	3 18	4100	17	31	1.6	2.3	7.05
1464	22	4 25	74	6.11	3 24	4200	18	32	1.6	2.4	7.26
1455	21	4 34	73	6.25	3 30	4300	18	32	1.7	2.5	7.46
1442	20	4 44	73	6.40	3 36	4400	19	33	1.7	2.6	7.67
1431	20	4 54	72	6.54	3 42	4500	20	33	1.7	2.8	7.88

RANGE TABLE for 9.2-inch B.L. Gun, Mark IX—*continued.*

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact		ELEVATION.	RANGE.	Fuze scale for fuze T. and P. middle No. 54, Marks I, II, or III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.	
f.s.	yards.	° /	yards.	yards.	° /	yards.		yards.	yards.	yards.	secs.
1420	19	5 4	71	6.69	3 48	4600	20½	34	1.7	3.0	8.09
1409	18	5 14	71	6.83	3 54	4700	21	34	1.8	3.1	8.29
1398	18	5 24	70	6.98	4 1	4800	21½	35	1.8	3.2	8.50
1387	17	5 34	69	7.13	4 7	4900	22½	35	1.8	3.4	8.72
1376	17	5 45	69	7.27	4 13	5000	22½	36	1.8	3.6	8.94
1365	16	5 55	68	7.42	4 19	5100	23½	36	1.9	3.8	9.15
1355	15	6 6	68	7.56	4 26	5200	24	37	1.9	4.0	9.37
1343	15	6 17	67	7.71	4 33	5300	24½	37	1.9	4.1	9.58
1332	15	6 28	67	7.85	4 40	5400	25	38	1.9	4.2	9.80
1321	14	6 40	66	8.00	4 46	5500	25½	38	2.0	4.3	10.02
1310	14	6 52	66	8.14	4 53	5600	26½	39	2.0	4.4	10.24
1297	13	7 4	65	8.29	4 59	5700	26½	39	2.0	4.6	10.46
1285	13	7 17	65	8.43	5 6	5800	27½	39	2.0	4.9	10.68
1274	13	7 29	64	8.58	5 12	5900	28	39	2.0	5.2	10.90
1264	12	7 42	64	8.73	5 19	6000	28½	40	2.1	5.4	11.13
1253	12	7 55	63	8.87	5 26	6100	29½	40	2.1	5.6	11.36
1243	11	8 8	63	9.01	5 34	6200	29½	40	2.1	5.7	11.60
1233	11	8 21	62	9.16	5 41	6300	...	40	2.1	5.8	11.82
1223	11	8 35	62	9.30	5 49	6400	...	41	2.2	5.9	12.08
1213	10	8 48	61	9.45	5 57	6500	...	41	2.2	6.2	12.33
1203	10	9 2	61	9.60	6 5	6600	...	41	2.2	6.5	12.58
1191	10	9 16	60	9.74	6 13	6700	...	41	2.2	6.8	12.83
1185	10	9 30	60	9.89	6 20	6800	...	41	2.2	7.2	13.08
1176	9	9 44	59	10.03	6 28	6900	...	41	2.3	7.5	13.34
1168	9	9 59	59	10.18	6 37	7000	...	41	2.3	7.8	13.60
1160	9	10 14	58	10.32	6 45	7100	...	41	2.3	8.1	13.85
1152	8	10 29	58	10.46	6 53	7200	...	42	2.3	8.4	14.10
1144	8	10 44	57	10.60	7 1	7300	...	42	2.3	8.6	14.35
1137	8	11 0	57	10.75	7 9	7400	...	42	2.4	8.9	14.60
1130	8	11 16	56	10.89	7 17	7500	...	42	2.4	9.1	14.86
1124	8	11 32	55	11.04	7 26	7600	...	42	2.4	9.4	15.13
1117	8	11 48	55	11.19	7 35	7700	...	42	2.4	9.6	15.39
1110	8	12 5	54	11.34	7 44	7800	...	42	2.4	9.9	15.66
1103	7	12 22	54	11.48	7 52	7900	...	42	2.5	10.2	15.91
1096	7	12 40	54	11.63	8 1	8000	...	42	2.5	10.5	16.17
1089	7	12 57	53	11.77	8 10	8100	...	42	2.5	10.6	16.43
1083	7	13 15	53	11.92	8 19	8200	...	42	2.5	10.7	16.70
1076	7	13 33	53	12.07	8 28	8300	...	41	2.5	10.6	16.97
1070	7	13 51	52	12.22	8 38	8400	...	41	2.5	10.5	17.24
1064	7	14 9	52	12.36	8 47	8500	...	41	2.6	10.4	17.51
1058	7	14 23	52	12.51	8 56	8600	...	41	2.6	10.3	17.78
1053	6	14 47	51	12.65	9 6	8700	...	41	2.6	10.2	18.06
1048	6	15 6	51	12.80	9 15	8800	...	40	2.6	10.2	18.34
1042	6	15 25	50	12.94	9 25	8900	...	40	2.6	10.4	18.62
1036	6	15 45	50	13.09	9 35	9000	...	40	2.6	10.6	18.90
1030	6	16 5	50	13.24	9 45	9100	...	40	2.7	10.8	19.18
1025	6	16 25	50	13.38	9 55	9200	...	39	2.7	11.0	19.46
1020	5	16 45	49	13.53	10 6	9300	...	39	2.7	11.4	19.74
1015	5	17 6	49	13.67	10 16	9400	...	39	2.7	11.2	20.03
1010	5	17 27	48	13.81	10 27	9500	...	38	2.7	11.5	20.33
1003	5	17 49	48	13.96	10 38	9600	...	38	2.7	11.6	20.63
1000	5	18 11	48	14.11	10 49	9700	...	38	2.7	11.7	20.91
995	5	18 33	47	14.26	11 0	9800	...	37	2.7	11.8	21.20
990	5	18 55	47	14.40	11 10	9900	...	37	2.8	11.9	21.49
985	5	19 18	47	14.55	11 21	10000	...	36	2.8	12.0	21.78
981	5	19 41	46	14.69	11 33	10100	...	36	2.8	12.0	22.06
977	4	20 4	46	14.84	11 45	10200	...	35	2.8	12.3	22.34
972	4	20 27	45	14.98	11 57	10300	...	35	2.8	12.6	22.62
968	4	20 50	45	15.13	12 10	10400	...	35	2.8	12.9	22.90
964	4	21 13	44	15.27	12 23	10500	...	34	2.8	13.2	23.18

RANGE TABLE for 9.2-inch B.L. Gun, Mark IX—continued.

Remaining velocity.	To strike an object 10 feet high range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact		ELEVATION.	RANGE.	Fuze scale for fuze T. and P. middle No. 54. Marks I, II, or III.	50 per cent. of rounds should fall within			Time of flight.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.	
f.s.	yards.	° /	yards.	yards.	° /	yards.		yards.	yards.	yards.	secs.
960	4	21 37	43	15.42	12 36	10600	...	34	2.8	13.5	23.46
955	4	22 1	42	15.56	12 49	10700	...	33	2.8	13.8	23.74
950	4	22 25	41	15.71	13 2	10800	...	33	2.9	14.1	24.03
946	4	22 49	40	15.86	13 15	10900	...	32	2.9	14.4	24.31
942	3	23 14	39	16.00	13 29	11000	...	32	2.9	14.7	24.60
938	3	23 39	38	16.15	13 42	11100	...	31	2.9	15.0	24.89
934	3	24 4	37	16.29	13 55	11200	...	31	2.9	15.2	25.18
929	3	24 29	36	16.43	14 9	11300	...	31	2.9	15.5	25.47
925	3	24 55	35	16.58	14 23	11400	...	30	2.9	15.7	25.75
920	3	25 21	35	16.73	14 36	11500	...	30	2.9	15.9	26.04
915	3	25 47	34	16.88	14 50	11600	...	29	2.9	16.1	26.34
910	3	26 13	34	17.02	15 3	11700	...	29	3.0	16.3	26.63

# RANGE TABLE for 9.2-inch B.L. Gun, Mark IX (Half Composite Charge).

Based on Practice of 23.7.00, previous to which the Gun had fired 8 proof and 40 full charges.

Minute 49,756 I (b).

Charge, { weight, 51½ lb.  
gravimetric density, 150.7  
nature, 40½ lb. cordite, size 14,  
and 2 lb. cordite, size 3½.

Muzzle velocity, 1,632 f.s.

Nature of mounting, barbette, Mark III.

Temperature, 75½ degrees Fahrenheit.

Jump, + 1 minute.

Projectile, { nature, cast-steel pointed  
common shell, Mark II.  
weight, 380 lb.

Remaining velocity (Actual).	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
f.s.	yards.	° /	yards.	yards.	° /	yards.		yards.	yards.	yards.	secs.
1617	818	0 7	81	0.14	0 5	100	1	...	...	...	0.19
1603	409	0 14	83	0.29	0 12	200	1	...	...	...	0.38
1589	273	0 21	82	0.43	0 18	300	1	...	...	...	0.57
1575	204	0 28	81	0.58	0 25	400	1	...	...	...	0.77
1561	161	0 35	80	0.72	0 31	500	2	...	...	...	0.96
1547	133	0 43	79	0.87	0 38	600	2	35.5	0.30	0.40	1.16
1538	112	0 51	78	1.01	0 45	700	3	36.3	0.32	0.49	1.35
1520	97	0 59	77	1.16	0 52	800	3	37.2	0.35	0.58	1.55
1503	87	1 6	76	1.31	0 59	900	4	38.0	0.37	0.68	1.75
1493	77	1 14	75	1.45	1 6	1000	4	38.9	0.40	0.78	1.95
1479	70	1 22	74	1.60	1 13	1100	5	39.7	0.42	0.90	2.15
1466	63	1 30	73	1.74	1 20	1200	5	40.6	0.45	1.03	2.35
1453	58	1 38	72	1.89	1 27	1300	6	41.4	0.47	1.16	2.55
1440	54	1 46	71	2.03	1 34	1400	6	42.3	0.50	1.30	2.76
1428	50	1 54	70	2.18	1 41	1500	7	43.2	0.52	1.45	2.97
1416	46	2 3	69	2.32	1 48	1600	7	44.2	0.55	1.61	3.18
1404	43	2 12	68	2.47	1 55	1700	8	45.2	0.58	1.78	3.39
1393	40	2 21	67	2.61	2 3	1800	9	46.2	0.61	1.95	3.60
1381	38	2 30	66	2.76	2 11	1900	9	47.3	0.64	2.12	3.81
1370	36	2 39	65	2.91	2 19	2000	10	48.4	0.67	2.29	4.03
1358	34	2 48	64	3.05	2 27	2100	10	49.5	0.70	2.47	4.24
1347	32	2 58	63	3.20	2 35	2200	11	50.6	0.73	2.67	4.46
1336	30	3 7	62	3.34	2 43	2300	11	51.7	0.76	2.89	4.68
1325	29	3 17	61	3.49	2 51	2400	12	52.9	0.79	3.12	4.90
1314	28	3 27	60	3.63	2 59	2500	12	54.1	0.82	3.36	5.12
1303	26	3 38	59	3.78	3 7	2600	13	55.3	0.85	3.62	5.35
1293	25	3 49	58	3.92	3 15	2700	14	56.5	0.88	3.90	5.58
1283	24	4 0	57	4.07	3 24	2800	14	57.8	0.91	4.20	5.82
1273	23	4 11	56	4.21	3 32	2900	15	59.1	0.94	4.52	6.06
1264	22	4 23	55	4.36	3 41	3000	16	60.4	0.97	4.86	6.30
1254	21	4 33	54	4.51	3 50	3100	16	61.8	1.00	5.22	6.55
1245	20	4 45	54	4.65	3 59	3200	17	63.2	1.04	5.59	6.80
1236	19	4 57	53	4.80	4 8	3300	17	64.7	1.07	5.97	7.05
1228	18	5 10	53	4.94	4 17	3400	18	66.2	1.11	6.36	7.30
1220	18	5 22	52	5.09	4 26	3500	19	67.7	1.15	6.76	7.55

RANGE TABLE for 9.2-inch B.L. Gun, Mark IX—*continued*.

Remaining velocity (Actual).	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
f.s.	yards.	° /	yards.	yards.	° /	yards.		yards.	yards.	yards.	secs.
1212	17	5 35	52	5 23	4 35	3600	10 1	69 3	1 19	7 17	7 80
1201	16	5 43	51	5 38	4 44	3700	20 1	70 8	1 24	7 53	8 05
1190	16	6 2	51	5 52	4 54	3800	21	72 4	1 29	8 02	8 30
1188	15	6 16	50	5 67	5 4	3900	21 1	74 0	1 34	8 46	8 55
1181	14	6 30	50	5 81	5 14	4000	22 1	75 6	1 40	9 00	8 81
1173	14	6 44	49	5 96	5 24	4100	23	77 3	1 46	9 5	9 07
1169	13	6 59	49	6 11	5 31	4200	23 1	79 0	1 52	10 1	9 33
1158	13	7 13	48	6 25	5 44	4300	24 1	80 7	1 58	10 7	9 59
1151	13	7 28	48	6 40	5 53	4400	25	82 4	1 65	11 3	9 86
1144	12	7 43	47	6 54	6 5	4500	25 1	84 1	1 72	11 9	10 13
1137	12	7 58	47	6 69	6 16	4600	26 1	85 9	1 80	12 5	10 40
1130	11	8 13	46	6 83	6 26	4700	27 1	87 6	1 88	13 1	10 67
1124	11	8 29	46	6 98	6 37	4800	28	89 4	1 96	13 7	10 95
1118	11	8 45	45	7 13	6 48	4900	28 1	91 1	2 04	14 4	11 22
1112	10	9 1	45	7 27	6 59	5000	29 1	92 9	2 13	15 1	11 50
1103	10	9 17	44	7 42	7 10	5100	30	94 7	2 21	15 8	11 77
1100	10	9 31	44	7 56	7 22	5200	...	96 5	2 30	16 6	12 05
1094	10	9 51	43	7 71	7 33	5300	...	98 3	2 39	17 5	12 33
1088	9	10 8	43	7 85	7 45	5400	...	100 2	2 48	18 4	12 61
1082	9	10 23	42	8 00	7 57	5500	...	102 1	2 58	19 3	12 89
1077	9	10 43	42	8 14	8 9	5600	...	104 0	2 68	20 2	13 18
1072	9	11 0	41	8 29	8 21	5700	...	105 9	2 78	21 2	13 47
1067	8	11 18	41	8 43	8 33	5800	...	107 9	2 88	22 2	13 76
1063	8	11 36	40	8 58	8 45	5900	...	109 8	2 98	23 2	14 05
1059	8	11 54	40	9 13	8 58	6000	...	111 8	3 08	24 3	14 35
1055	8	12 12	39	9 27	9 11	6100	...	113 7	3 18	25 4	14 65
1051	8	12 31	39	9 41	9 24	6200	...	115 7	3 28	26 5	14 95
1047	7	12 49	38	9 56	9 37	6300	...	117 7	3 38	27 6	15 25
1044	7	13 8	38	10 10	9 50	6400	...	119 7	3 48	28 7	15 55
1040	7	13 26	38	10 25	10 3	6500	...	121 7	3 58	29 8	16 25
1037	7	13 45	38	10 40	10 16	6600	...	123 7	3 68	30 9	16 55
1033	7	14 4	37	10 54	10 29	6700	...	125 7	3 78	32 1	17 25
1030	6	14 23	37	11 09	10 43	6800	...	127 8	3 88	33 4	17 55
1027	6	14 42	37	11 23	10 56	6900	...	129 8	3 98	34 7	18 25
1024	6	15 1	37	11 38	11 10	7000	...	131 9	4 08	36 0	18 55
1021	6	15 20	36	11 52	11 23	7100	...	133 9	4 19	37 3	19 25
1018	6	15 40	36	12 06	11 37	7200	...	136 0	4 30	38 6	19 55
1015	6	16 0	36	12 20	11 51	7300	...	138 0	4 41	39 9	20 25
1012	6	16 20	36	12 34	12 5	7400	...	140 1	4 52	41 2	20 55
1009	6	16 40	36	12 48	12 19	7500	...	142 1	4 63	42 5	21 25
1006	5	17 1	36	13 02	12 33	7600	...	144 2	4 74	43 8	21 55
1003	5	17 21	36	13 16	12 47	7700	...	146 2	4 85	45 1	22 25
1000	5	17 41	36	13 30	13 1	7800	...	148 3	4 96	46 5	22 55
997	5	18 2	36	13 44	13 15	7900	...	150 3	5 07	48 0	23 25
994	5	18 22	36	13 58	13 29	8000	...	152 4	5 18	49 6	23 55

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X.  
(Composite, Full Charge.)

Based on Practice of 16.7.00.

40185  
0259  
40185  
5552

*Minute 49,687. I.*

Charge,	{	weight, 103 lb.	Muzzle velocity, 2643 f.s.
		gravimetric density, $\frac{78.8}{0.351}$ .	
		nature, 99 lb. cordite, size 44; and 4 lb., size 3 $\frac{1}{2}$ .	Nature of mounting, barbette, Mark III.
Projectile,	{	nature, cast steel, pointed, com- mon shell, Mark II.	Jump, 7 $\frac{1}{2}$ minutes, negative.
		weight, 380 lb.	

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	° /	yards.	yards.	° /	yards.	...	yards.	yards.	yards.	seconds.	inches.
2616	2864	0 3	232	0 14	0 11	100	...	...	...	...	0.11	32.56
2592	1146	0 6	230	0.29	0 14	200	...	...	...	...	0.23	32.12
2568	767	0 7	228	0.43	0 16	300	...	...	...	...	0.35	31.69
2544	572	0 10	226	0.58	0 19	400	...	...	...	...	0.47	31.26
2520	485	0 12	224	0.72	0 21	500	...	...	...	...	0.59	30.84
2496	382	0 15	222	0.87	0 24	600	1 $\frac{1}{2}$	20.5	0.25	0.15	0.71	30.43
2472	318	0 18	220	1.01	0 26	700	1 $\frac{1}{2}$	20.7	0.28	0.16	0.83	30.03
2448	274	0 21	218	1.16	0 29	800	2	20.8	0.31	0.17	0.95	29.63
2424	239	0 24	216	1.31	0 31	900	2 $\frac{1}{2}$	20.9	0.35	0.18	1.07	29.24
2400	212	0 27	214	1.45	0 34	1000	2 $\frac{1}{2}$	21.1	0.38	0.19	1.19	28.83
2377	191	0 30	212	1.60	0 36	1100	3	21.3	0.40	0.20	1.31	28.43
2354	173	0 33	210	1.74	0 39	1200	3 $\frac{1}{2}$	21.4	0.43	0.22	1.43	28.03
2332	159	0 36	208	1.89	0 41	1300	3 $\frac{1}{2}$	21.6	0.47	0.24	1.55	27.63
2310	145	0 40	206	2.03	0 44	1400	4	21.7	0.50	0.26	1.68	27.23
2288	131	0 43	204	2.18	0 46	1500	4 $\frac{1}{2}$	21.8	0.54	0.28	1.80	26.84
2267	125	0 46	202	2.32	0 49	1600	4 $\frac{1}{2}$	22.0	0.57	0.30	1.93	26.46
2246	117	0 49	200	2.47	0 51	1700	5	22.2	0.59	0.32	2.06	26.02
2225	109	0 53	198	2.61	0 54	1800	5 $\frac{1}{2}$	22.4	0.61	0.34	2.19	25.70
2205	102	0 56	196	2.76	0 57	1900	5 $\frac{1}{2}$	22.5	0.63	0.36	2.32	25.35
2185	97	0 59	194	2.91	1 0	2000	5 $\frac{1}{2}$	22.6	0.66	0.38	2.46	25.00
2165	92	1 2	192	3.05	1 3	2100	6 $\frac{1}{2}$	22.8	0.69	0.40	2.60	24.65
2146	88	1 5	190	3.20	1 6	2200	6 $\frac{1}{2}$	23.0	0.71	0.43	2.74	24.30
2127	84	1 8	188	3.34	1 9	2300	6 $\frac{1}{2}$	23.2	0.74	0.46	2.88	23.96
2108	79	1 12	186	3.49	1 12	2400	7 $\frac{1}{2}$	23.4	0.77	0.51	3.02	23.63
2090	75	1 16	184	3.63	1 15	2500	7 $\frac{1}{2}$	23.6	0.80	0.56	3.16	23.31
2072	71	1 20	182	3.78	1 18	2600	8	23.8	0.83	0.59	3.30	23.00
2055	68	1 24	180	3.92	1 21	2700	8 $\frac{1}{2}$	24.0	0.85	0.63	3.44	22.69
2038	65	1 28	178	4.07	1 24	2800	8 $\frac{1}{2}$	24.3	0.88	0.68	3.59	22.38
2021	62	1 32	176	4.21	1 27	2900	9	24.5	0.90	0.73	3.73	22.09
2004	59	1 36	174	4.35	1 31	3000	9 $\frac{1}{2}$	24.8	0.92	0.78	3.88	21.80
1988	57	1 40	172	4.51	1 34	3100	10	25.0	0.94	0.83	4.03	21.51
1972	55	1 44	170	4.65	1 38	3200	10 $\frac{1}{2}$	25.2	0.97	0.88	4.18	21.22
1956	53	1 48	168	4.80	1 41	3300	10 $\frac{1}{2}$	25.5	1.00	0.93	4.33	20.97
1940	51	1 52	166	4.94	1 45	3400	11	25.7	1.03	0.98	4.49	20.72
1925	49	1 56	164	5.09	1 48	3500	11 $\frac{1}{2}$	26.0	1.05	1.03	4.64	20.47
1910	48	2 0	162	5.23	1 52	3600	12	26.2	1.08	1.08	4.80	20.22
1895	46	2 4	160	5.38	1 55	3700	12 $\frac{1}{2}$	26.5	1.10	1.14	4.95	19.97
1880	44	2 9	158	5.52	1 59	3800	12 $\frac{1}{2}$	26.8	1.13	1.20	5.11	19.73
1865	43	2 13	156	5.67	2 2	3900	13 $\frac{1}{2}$	27.0	1.17	1.26	5.27	19.50
1850	41	2 18	154	5.81	2 6	4000	13 $\frac{1}{2}$	27.3	1.20	1.32	5.43	19.27

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact			ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 51, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally.					Length.	Breadth.	Height.		
f.s.	yards.	° ' "	yards.	yards.	° ' "	yards.			yards.	yards.	yard.	seconds.	inches.
1836	40	2 23	152	5.96	2 9	4100	14	27.7	1.23	1.38	5.50	19.05	
1822	39	2 28	150	6.11	2 13	4200	14½	27.9	1.26	1.45	5.75	18.84	
1809	37	2 33	148	6.25	2 16	4300	14½	28.2	1.27	1.52	5.91	18.62	
1796	36	2 38	146	6.40	2 20	4400	15½	28.5	1.30	1.59	6.07	18.41	
1783	35	2 43	144	6.54	2 23	4500	15½	28.8	1.33	1.66	6.23	18.20	
1770	34	2 49	142	6.69	2 27	4600	16	29.2	1.36	1.74	6.40	18.00	
1757	33	2 54	140	6.83	2 31	4700	16½	29.5	1.40	1.82	6.56	17.81	
1744	32	3 0	134	6.98	2 35	4800	17	29.8	1.43	1.90	6.73	17.62	
1731	31	3 5	136	7.13	2 39	4900	17½	30.1	1.47	1.98	6.89	17.48	
1718	30	3 11	134	7.27	2 43	5000	17½	30.4	1.50	2.06	7.06	17.25	
1705	29	3 17	132	7.42	2 47	5100	18½	30.8	1.54	2.14	7.22	17.07	
1692	28	3 23	130	7.53	2 51	5200	18½	31.1	1.58	2.22	7.39	16.89	
1679	27	3 29	128	7.71	2 55	5300	19	31.5	1.62	2.30	7.55	16.71	
1667	26	3 35	126	7.85	2 59	5400	19½	31.8	1.66	2.38	7.72	16.53	
1655	26	3 41	124	8.00	3 3	5500	20	32.2	1.70	2.46	7.89	16.36	
1643	25	3 48	122	8.14	3 7	5600	20½	32.6	1.74	2.54	8.06	16.20	
1632	24	3 55	120	8.29	3 11	5700	20½	33.0	1.77	2.62	8.23	16.05	
1621	23	4 2	118	8.43	3 15	5800	21½	33.4	1.80	2.70	8.41	15.90	
1610	23	4 9	116	8.58	3 19	5900	21½	33.8	1.84	2.78	8.58	15.75	
1600	22	4 16	114	8.73	3 23	6000	22½	34.2	1.88	2.86	8.76	15.60	
1590	21	4 23	112	8.87	3 27	6100	22½	34.6	1.92	2.95	8.94	15.47	
1580	21	4 30	111	9.01	3 32	6200	23½	35.0	1.96	3.05	9.12	15.34	
1570	20	4 37	110	9.15	3 36	6300	23½	35.4	2.01	3.16	9.30	15.22	
1560	20	4 45	109	9.30	3 41	6400	24	35.8	2.05	3.28	9.49	15.10	
1550	19	4 53	108	9.45	3 45	6500	24½	36.3	2.09	3.40	9.68	14.99	
1540	19	5 1	107	9.60	3 50	6600	25	36.6	2.13	3.52	9.88	14.88	
1530	18	5 9	106	9.74	3 54	6700	25½	37.1	2.17	3.64	10.07	14.78	
1520	18	5 18	105	9.89	3 59	6800	26	37.6	2.21	3.77	10.27	14.68	
1510	17	5 27	104	10.03	4 4	6900	26½	38.0	2.25	3.91	10.46	14.58	
1501	17	5 36	103	10.18	4 9	7000	27	38.4	2.29	4.06	11.66	14.48	
1491	17	5 45	102	10.32	4 14	7100	27½	38.8	2.31	4.22	10.85	14.38	
1482	16	5 51	101	10.46	4 19	7200	28	39.3	2.38	4.38	11.05	14.29	
1472	16	6 3	103	10.60	4 24	7300	28½	39.6	2.42	4.54	11.24	14.20	
1463	15	6 13	99	10.75	4 29	7400	29	40.1	2.46	4.70	11.44	14.11	
1454	15	6 23	98	10.89	4 34	7500	29½	40.7	2.51	4.86	11.63	14.02	
1445	14	6 33	97	11.04	4 40	7600	30	41.2	2.55	5.0	11.83	13.93	
1436	14	6 43	96	11.19	4 45	7700	...	41.7	2.59	5.2	12.03	13.84	
1427	14	6 54	95	11.34	4 51	7800	...	42.2	2.63	5.4	12.23	13.76	
1418	13	7 4	94	11.48	4 57	7900	...	42.7	2.66	5.6	12.43	13.67	
1409	13	7 15	93	11.63	5 3	8000	...	43.2	2.70	5.8	12.64	13.59	
1400	13	7 26	92	11.77	5 9	8100	...	43.7	2.74	6.0	12.84	13.50	
1391	12	7 37	91	11.92	5 15	8200	...	44.3	2.78	6.2	13.05	13.42	
1382	12	7 44	90	12.07	5 21	8300	...	44.8	2.82	6.4	13.26	13.33	
1374	12	8 0	89	12.22	5 27	8400	...	45.4	2.86	6.6	13.47	13.25	
1363	12	8 12	88	12.36	5 33	8500	...	45.9	2.90	6.8	13.68	13.16	
1357	11	8 21	87	12.51	5 39	8600	...	46.5	2.95	7.0	13.90	13.08	
1348	11	8 46	86	12.65	5 45	8700	...	47.0	3.00	7.2	14.12	12.99	
1340	11	8 49	85	12.80	5 51	8800	...	47.6	3.05	7.4	14.34	12.91	
1332	10	9 3	84	12.94	5 57	8900	...	48.2	3.11	7.6	14.56	12.82	
1324	10	9 15	83	13.09	6 3	9000	...	48.8	3.17	7.8	14.79	12.74	
1316	10	9 28	82	13.24	6 9	9100	...	49.3	3.23	8.0	15.01	12.65	
1308	10	9 42	81	13.38	6 16	9200	...	49.8	3.30	8.3	15.24	12.57	
1300	10	9 56	80	13.53	6 22	9300	...	50.4	3.37	8.6	15.47	12.49	
1292	9	10 10	79	13.67	6 29	9400	...	51.0	3.44	8.9	15.70	12.41	
1284	9	10 24	78	13.81	6 35	9500	...	51.6	3.52	9.2	15.93	12.33	
1276	9	10 38	77	13.96	6 42	9600	...	52.2	3.61	9.5	16.17	12.25	
1268	9	10 52	77	14.11	6 48	9700	...	52.8	3.70	9.8	16.41	12.16	
1261	8	11 7	76	14.26	6 55	9800	...	53.3	3.79	10.1	16.66	12.08	
1253	8	11 22	75	14.40	7 1	9900	...	53.9	3.89	10.4	16.91	11.99	
1246	8	11 37	74	14.55	7 8	10000	...	54.5	4.00	10.7	17.16	11.91	



RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	° ' "	yards.	yards.	° ' "	yards.	...	yards.	yards.	yards.	seconds.	inches.
1238	8	11 52	73	14 59	7 14	10100	...	55 0	4 10	11 0	17 41	11 32
1231	8	12 8	72	14 84	7 21	10200	...	55 6	4 22	11 3	17 66	11 74
1224	8	12 23	72	14 98	7 28	10300	...	56 2	4 34	11 6	17 91	11 66
1217	7	12 38	71	15 13	7 35	10400	...	56 8	4 46	11 9	18 16	11 58
1210	7	12 53	71	15 27	7 42	10500	...	57 3	4 58	12 3	18 41	11 50
1203	7	13 9	70	15 42	7 49	10600	...	58 0	4 70	12 7	18 67	11 42
1196	7	13 24	69	15 56	7 56	10700	...	58 6	4 83	13 1	18 93	11 34
1189	7	13 40	68	15 71	8 3	10800	...	59 2	4 97	13 5	19 19	11 27
1182	7	13 55	67	15 85	8 10	10900	...	59 8	5 12	13 9	19 45	11 19
1175	7	14 11	68	16 00	8 18	11000	...	60 3	5 27	14 3	19 72	11 12
1168	6	14 26	65	16 14	8 25	11100	...	60 8	5 42	14 7	19 99	11 05
1161	6	14 42	64	16 29	8 33	11200	...	61 5	5 58	15 1	20 26	10 98
1154	6	14 58	63	16 43	8 41	11300	...	62 2	5 76	15 5	20 54	10 91
1147	6	15 15	62	16 58	8 49	11400	...	62 8	5 92	15 9	20 82	10 84
1140	6	15 31	61	16 72	8 57	11500	...	63 4	6 10	16 3	21 10	10 77
1134	6	15 48	60	16 87	9 6	11600	...	64 0	6 27	16 7	21 39	10 70
1127	6	16 4	59	17 01	9 14	11700	...	64 6	6 45	17 1	21 68	10 63
1121	6	16 21	58	17 16	9 23	11800	...	65 2	6 64	17 5	21 98	10 56
1114	6	16 37	58	17 30	9 31	11900	...	65 8	6 83	17 9	22 28	10 49
1108	5	16 54	57	17 45	9 40	12000	...	66 5	7 03	18 3	22 58	10 42
1101	5	17 11	57	17 59	9 49	12100	...	67 1	7 23	18 7	22 88	10 35
1095	5	17 28	56	17 74	9 58	12200	...	67 7	7 42	19 1	23 18	10 28
1088	5	17 45	55	17 88	10 7	12300	...	68 3	7 62	19 5	23 48	10 21
1082	5	18 3	54	18 03	10 16	12400	...	69 0	7 83	19 9	23 78	10 15
1075	5	18 20	53	18 17	10 25	12500	...	69 6	8 05	20 3	24 08	10 08
1069	5	18 33	52	18 32	10 35	12600	...	70 2	8 26	20 7	24 39	10 02
1063	5	18 55	51	18 46	10 45	12700	...	70 8	8 50	21 1	24 69	9 95
1057	5	19 13	50	18 61	10 55	12800	...	71 5	9 14	21 5	25 00	9 89
1051	5	19 31	49	18 75	11 5	12900	...	72 0	9 40	21 9	25 31	9 82
1045	5	19 49	48	18 90	11 15	13000	...	72 6	9 25	22 3	25 62	9 76
1039	5	20 7	48	19 04	11 25	13100	...	73 3	9 50	22 7	25 94	9 69
1033	4	20 25	47	19 19	11 36	13200	...	73 8	9 75	23 1	26 26	9 63
1027	4	20 43	47	19 33	11 46	13300	...	74 5	10 00	23 5	26 58	9 56
1021	4	21 1	46	19 48	11 57	13400	...	75 1	10 28	23 9	26 91	9 50
1015	4	21 19	46	19 62	12 8	13500	...	75 7	10 53	24 3	27 24	9 43
1010	4	21 38	45	19 77	12 19	13600	...	76 4	10 82	24 7	27 57	9 37
1004	4	21 56	45	19 91	12 30	13700	...	77 1	11 10	25 1	27 90	9 30
999	4	22 15	44	20 06	12 41	13800	...	77 7	11 40	25 5	28 24	9 24
993	4	22 32	44	20 20	12 52	13900	...	78 4	11 70	25 9	28 58	9 17
988	4	22 52	44	20 35	13 3	14000	...	79 0	12 00	26 3	28 92	9 11

The proportional resistance to penetration of wrought-iron, compound or mild steel, and Harveyd armour, may be taken roughly as 1:1½:2.

A 9.2-inch common shell, with a velocity of about 2,000 f.s., may be expected to perforate about 6 inches of Harveyd armour, if struck direct, or about 5 inches at 30° to the normal.

Under similar circumstances, a 9.2-inch armour-piercing shell may be expected to perforate about 9 inches and 7 inches Harveyd armour, and it would probably perforate 9 inches of compound or mild steel if struck direct or at an angle of 30° to the normal.

# RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X. ( $\frac{3}{4}$ Composite Charge.)

Based on Practice of 30.7.00.

(Minute 49,756, III (a).)

Charge,	{	weight, 77½ lb.	{	Muzzle velocity, 2196 f.s.
		gravimetric density, $\frac{106.7}{0.260}$		
Projectile,	{	nature, { 74½ lb. cordite, size 44 and 3 lb. cordite, size 3½.	{	Nature of mounting, barbette, Mark III.
		nature, cast steel, pointed common shell, Mark II.		
		weight, 380 lb.		Jump, 7½ minutes, negative.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 84, Marks I*, II, or III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
f.s.	yards.	° /	yards.	yards.	° /	yards.		yards.	yards.	yards.	seconds
2174	1432	0 4	142	0.14	0 11	100	1	...	...	...	0.14
2153	714	0 8	140	0.29	0 14	200	1	...	...	...	0.29
2131	477	0 12	138	0.43	0 18	300	1	...	...	...	0.43
2110	358	0 16	136	0.58	0 22	400	1	...	...	...	0.58
2088	286	0 20	134	0.72	0 26	500	1	...	...	...	0.73
2067	229	0 25	132	0.87	0 30	600	2	21.0	0.35	0.1	0.88
2046	197	0 29	130	1.01	0 34	700	2	21.4	0.37	0.1	1.03
2025	169	0 34	128	1.16	0 38	800	2	21.9	0.40	0.1	1.18
2002	151	0 38	126	1.31	0 42	900	3	22.3	0.42	0.1	1.33
1985	133	0 43	124	1.45	0 46	1000	3	22.8	0.45	0.1	1.48
1965	122	0 47	122	1.60	0 50	1100	4	23.2	0.47	0.1	1.63
1946	110	0 52	121	1.74	0 54	1200	4	23.7	0.50	0.1	1.78
1927	100	0 57	120	1.89	0 58	1300	4	24.1	0.52	0.2	1.93
1908	92	1 2	119	2.03	1 2	1400	5	24.6	0.55	0.2	2.09
1890	87	1 6	118	2.18	1 1	1500	5	25.0	0.57	0.3	2.24
1872	81	1 11	117	2.32	1 10	1600	6	25.5	0.60	0.3	2.40
1855	75	1 16	116	2.47	1 14	1700	6	25.9	0.63	0.4	2.56
1838	71	1 21	115	2.61	1 18	1800	6	26.4	0.66	0.4	2.72
1821	66	1 26	114	2.76	1 22	1900	7	26.8	0.69	0.5	2.88
1805	63	1 31	113	2.91	1 26	2000	7	27.3	0.72	0.5	3.04
1789	59	1 36	112	3.05	1 30	2100	8	27.7	0.76	0.6	3.20
1773	56	1 41	111	3.20	1 34	2200	8	28.2	0.80	0.6	3.37
1757	54	1 46	110	3.34	1 38	2300	8	28.7	0.84	0.7	3.53
1742	51	1 52	109	3.49	1 42	2400	9	29.2	0.88	0.8	3.70
1727	49	1 57	108	3.63	1 46	2500	9	29.7	0.92	0.9	3.86
1718	46	2 3	107	3.78	1 51	2600	10	30.2	0.96	1.0	4.03
1699	44	2 9	106	3.92	1 55	2700	10	30.7	1.00	1.1	4.20
1685	42	2 15	105	4.07	2 0	2800	11	31.2	1.04	1.2	4.37
1671	40	2 21	104	4.21	2 4	2900	11	31.7	1.08	1.3	4.54
1657	39	2 27	103	4.36	2 9	3000	11	32.2	1.12	1.4	4.71

RANGE TABLE for 9.2-inch B.L. Gun, Marks IX and X—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I, II, or III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
f.s.	yards.	° /	yards.	yards.	° /	yards.		yards.	yards.	yards.	seconds.
1643	37	2 33	102	4 51	2 14	3100	12½	32.8	1.16	1.5	4.88
1630	36	2 39	101	4 55	2 19	3200	12½	33.4	1.20	1.6	5.05
1616	34	2 45	100	4 50	2 24	3300	13½	34.0	1.24	1.7	5.22
1603	33	2 52	99	4 54	2 29	3400	13½	34.6	1.23	1.8	5.40
1589	32	2 59	98	5 09	2 32	3500	14	35.2	1.33	1.9	5.58
1576	31	3 6	97	5 23	2 39	3600	14½	35.8	1.38	2.0	5.76
1563	29	3 13	96	5 38	2 44	3700	15	36.4	1.43	2.1	5.94
1550	28	3 21	95	5 52	2 50	3800	15½	37.0	1.48	2.2	6.12
1537	27	3 28	94	5 67	2 55	3900	16	37.6	1.53	2.3	6.30
1524	26	3 36	93	5 81	3 1	4000	16½	38.2	1.54	2.4	6.49
1511	25	3 44	92	5 96	3 6	4100	17	38.8	1.63	2.6	6.68
1499	24	3 52	91	6 11	3 12	4200	17½	39.4	1.68	2.8	6.87
1486	24	4 0	90	6 25	3 17	4300	18	40.0	1.73	3.0	7.06
1474	23	4 9	89	6 40	3 23	4400	18½	40.6	1.78	3.2	7.26
1461	22	4 17	88	6 54	3 28	4500	19	41.3	1.83	3.4	7.46
1449	22	4 26	87	6 69	3 34	4600	19½	42.0	1.88	3.6	7.66
1436	21	4 35	86	6 83	3 40	4700	20	42.7	1.93	3.8	7.86
1424	20	4 44	85	6 98	3 46	4800	20½	43.4	1.99	4.0	8.07
1412	19	4 53	84	7 13	3 52	4900	21	44.1	2.04	4.2	8.27
1400	19	5 3	83	7 27	3 58	5000	21½	44.9	2.10	4.4	8.48
1388	18	5 13	82	7 42	4 4	5100	22	45.6	2.15	4.6	8.69
1376	18	5 23	81	7 56	4 10	5200	22½	46.4	2.21	4.8	8.90
1364	17	5 33	80	7 71	4 16	5300	23½	47.1	2.26	5.0	9.11
1353	17	5 43	79	7 85	4 22	5400	23½	47.9	2.32	5.2	9.33
1341	16	5 53	78	8 00	4 28	5500	24½	48.6	2.37	5.4	9.54
1330	16	6 4	77	8 14	4 34	5600	25	49.4	2.43	5.6	9.76
1319	15	6 15	76	8 29	4 40	5700	25½	50.2	2.49	5.9	9.98
1308	15	6 26	75	8 43	4 47	5800	26	51.0	2.55	6.2	10.20
1297	14	6 27	74	8 58	4 53	5900	26½	51.9	2.61	6.5	10.42
1287	14	6 48	73	8 73	5 0	6000	27½	52.8	2.67	6.8	10.65
1276	13	6 59	72	8 87	5 7	6100	28½	53.7	2.73	7.1	10.88
1266	13	7 11	71	9 01	5 14	6200	28½	54.6	2.80	7.4	11.11
1256	13	7 22	70	9 16	5 21	6300	29	55.5	2.86	7.8	11.34
1246	12	7 34	69	9 30	5 28	6400	29½	56.4	2.93	8.1	11.58
1236	12	7 46	68	9 45	5 35	6500	...	57.3	2.99	8.5	11.81
1227	12	7 58	67	9 60	5 42	6600	...	58.3	3.06	8.8	12.05
1218	11	8 9	66	9 74	5 49	6700	...	59.2	3.12	9.3	12.29
1209	11	8 21	65	9 89	5 57	6800	...	60.2	3.19	9.9	12.53
1200	11	8 33	64	10 03	6 4	6900	...	61.2	3.25	10.0	12.77
1192	11	8 45	63	10 18	6 12	7000	...	62.2	3.32	10.4	13.02
1184	10	8 57	63	10 32	6 20	7100	...	63.3	3.38	10.8	13.26
1176	10	9 10	62	10 46	6 28	7200	...	64.4	3.45	11.2	13.51
1168	10	9 23	62	10 60	6 36	7300	...	65.5	3.51	11.6	13.75
1161	9	9 36	61	10 75	6 44	7400	...	66.7	3.58	12.1	14.00
1154	9	9 49	61	10 89	6 52	7500	...	67.8	3.64	12.6	14.24
1147	9	10 3	60	11 04	7 0	7600	...	69.0	3.71	13.1	14.49
1140	9	10 17	60	11 19	7 8	7700	...	70.02	3.77	13.6	14.74
1133	9	10 31	59	11 34	7 16	7800	...	71.4	3.84	14.2	14.99
1126	8	10 45	59	11 48	7 24	7900	...	72.6	3.90	14.8	15.24
1119	8	11 0	58	11 63	7 33	8000	...	73.8	3.97	15.4	15.49
1112	8	11 15	58	11 77	7 41	8100	...	75.0	4.04	16.0	15.74
1106	8	11 30	57	11 92	7 50	8200	...	76.3	4.11	16.6	16.00
1100	8	11 45	57	12 07	7 58	8300	...	77.6	4.18	17.2	16.25
1094	7	12 1	56	12 22	8 7	8400	...	78.9	4.25	17.8	16.51
1088	7	12 17	56	12 36	8 16	8500	...	80.2	4.32	18.4	16.76
1082	7	12 33	55	12 51	8 25	8600	...	81.6	4.39	19.0	17.02
1076	7	12 49	55	12 65	8 34	8700	...	83.0	4.46	19.6	17.28
1070	7	13 6	54	12 80	8 44	8800	...	84.4	4.53	20.3	17.54
1064	7	13 22	54	12 94	8 53	8900	...	85.8	4.60	21.0	17.80
1059	6	13 39	53	13 09	9 3	9000	...	87.2	4.68	21.7	18.07

RANGE TABLE for 9.2-inch B.L. Gun, Marks IX and X—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within		Angle of descent.		5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I*, II, or III.	50 per cent. of rounds should fall in			Time of flight.
f.s.	yards.	° /	yards.	yards.	° /	yards.				yards.	yards	yards.	seconds.
1053	6	13 56	53	13.24	9 12	9100	...	...	...	88.6	4.75	22.4	18.34
1048	6	14 13	52	13.38	9 22	9210	...	...	...	90.0	4.83	23.1	18.61
1042	6	14 30	52	13.53	9 32	9300	...	...	...	91.4	4.91	23.8	18.89
1037	6	14 48	51	13.67	9 42	9400	...	...	...	92.8	4.99	24.6	19.17
1032	6	15 6	51	13.81	9 52	9500	...	...	...	94.2	5.07	25.4	19.45
1027	6	15 24	50	13.96	10 2	9600	...	...	...	95.7	5.15	26.3	19.74
1022	6	15 42	50	14.11	10 12	9700	...	...	...	97.2	5.23	27.1	20.03
1018	5	16 0	49	14.26	10 22	9800	...	...	...	98.8	5.31	28.0	20.32
1013	5	16 18	49	14.40	10 32	9900	...	...	...	100.3	5.39	28.9	20.61
1009	5	16 37	48	14.55	10 42	10000	...	...	...	101.9	5.47	29.9	20.91
1004	5	16 54	48	14.69	10 52	10100	...	...	...	103.5	5.55	30.9	21.21
1000	5	17 14	47	14.84	11 3	10200	...	...	...	105.1	5.64	32.0	21.51
996	5	17 33	47	14.99	11 13	10300	...	...	...	106.7	5.73	33.0	21.81
992	5	17 52	46	15.13	11 24	10400	...	...	...	108.3	5.82	34.1	22.12
988	5	18 11	46	15.27	11 35	10500	...	...	...	109.9	5.91	35.1	22.43
985	5	18 30	45	15.42	11 46	10600	...	...	...	111.5	6.01	36.2	22.74
982	4	18 49	45	15.56	11 57	10700	...	...	...	113.1	6.11	37.2	23.05
979	4	19 9	44	15.71	12 8	10800	...	...	...	114.7	6.21	38.3	23.36
976	4	19 28	44	15.85	12 19	10900	...	...	...	116.3	6.31	39.4	23.67
974	4	19 48	43	16.00	12 31	11000	...	...	...	117.9	6.41	40.5	23.99
972	4	20 8	43	16.14	12 42	11100	...	...	...	119.5	6.51	41.6	24.31
970	4	20 28	42	16.29	12 54	11200	...	...	...	121.1	6.61	42.7	24.63
968	4	20 48	42	16.43	13 5	11300	...	...	...	122.7	6.71	43.8	24.95
966	4	21 9	41	16.58	13 17	11400	...	...	...	124.3	6.81	45.0	25.28
964	4	21 29	41	16.72	13 29	11500	...	...	...	125.9	6.91	46.1	25.60
962	4	21 50	40	16.87	13 41	11600	...	...	...	127.5	7.01	47.3	25.98
960	4	22 10	40	17.01	13 53	11700	...	...	...	129.1	7.11	48.5	26.26
958	4	22 31	39	17.16	14 5	11800	...	...	...	130.7	7.21	49.7	26.59
956	4	22 51	39	17.30	14 15	11900	...	...	...	132.3	7.31	50.9	26.92
954	3	23 12	39	17.45	14 27	12000	...	...	...	133.9	7.41	52.1	27.26

# RANGE TABLE for 9.2-inch B.L. Gun, Mark IX (Full Charge).

Based on Practice of 11 and 13.7.98, and 6.12.98.

40,185  
8778

Minutes 45,700, 46,518 III (b).

Charge, { weight, 100 lb.  
gravimetric density,  $\frac{81.0}{0.312}$ .  
nature, cordite, size 41.

Muzzle velocity, 2,601 f.s.

Nature of Mounting, barbette, Mark IV.

Projectile, { nature, common shell, pointed,  
Mark II.  
weight, 379 lb.

Jump + 2½ minutes.

Corrected for gun on same level as target.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for time and percussion, middle, No. 54, Marks I, II, or III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.		
f.s.	yards.	° '	yards.	yards.	° '	yards.		yards.	yards.	yards.	secs.	inches.
2571	2833	0 3	250	0.14	0 0	100	1	10.8	0.10	0.08	0.12	32.0
2542	950	0 6	166	0.29	0 3	200	1	20.0	0.13	0.09	0.24	31.5
2513	635	0 9	164	0.43	0 6	300	1	20.01	0.16	0.11	0.30	31.0
2485	477	0 12	162	0.58	0 9	400	1	20.03	0.18	0.14	0.48	30.5
2457	381	0 15	160	0.72	0 11	500	1	20.04	0.21	0.15	0.60	30.0
2431	317	0 18	158	0.87	0 13	600	1	20.05	0.25	0.16	0.72	29.5
2404	285	0 21	156	1.01	0 16	700	2	20.07	0.28	0.18	0.84	29.0
2376	245	0 24	154	1.16	0 19	800	2	20.08	0.31	0.20	0.96	28.5
2350	207	0 27	152	1.31	0 21	900	2	20.09	0.35	0.21	1.09	28.0
2325	178	0 31	150	1.45	0 24	1000	3	21.1	0.38	0.24	1.22	27.5
2300	160	0 34	148	1.60	0 27	1100	3	21.3	0.40	0.25	1.34	27.0
2274	145	0 38	146	1.74	0 30	1200	3	21.4	0.43	0.27	1.47	26.6
2250	133	0 41	144	1.89	0 33	1300	4	21.6	0.47	0.29	1.60	26.2
2226	122	0 45	143	2.03	0 36	1400	4	21.7	0.50	0.31	1.73	25.8
2203	113	0 48	141	2.18	0 39	1500	4	21.8	0.54	0.34	1.86	25.4
2180	106	0 52	139	2.32	0 42	1600	5	22.0	0.57	0.37	2.00	25.0
2157	100	0 55	138	2.47	0 45	1700	5	22.2	0.59	0.39	2.14	24.6
2135	93	0 59	137	2.61	0 48	1800	5	22.4	0.61	0.41	2.28	24.2
2115	88	1 2	135	2.76	0 51	1900	6	22.5	0.63	0.43	2.41	23.8
2095	83	1 6	133	2.91	0 54	2000	6	22.6	0.66	0.45	2.55	23.5
2075	80	1 9	131	3.05	0 57	2100	6	22.8	0.69	0.50	2.69	23.2
2055	77	1 13	129	3.20	1 1	2200	7	23.0	0.71	0.52	2.83	22.8
2036	75	1 16	128	3.34	1 4	2300	7	23.2	0.74	0.55	2.98	22.5
2017	72	1 20	127	3.49	1 7	2400	8	23.4	0.77	0.58	3.13	22.2
1998	68	1 24	125	3.63	1 11	2500	8	23.6	0.80	0.61	3.28	21.9
1980	65	1 28	124	3.78	1 15	2600	8	23.8	0.83	0.64	3.43	21.6
1963	61	1 32	123	3.92	1 18	2700	9	24.0	0.85	0.68	3.58	21.3
1945	60	1 36	123	4.07	1 21	2800	9	24.3	0.88	0.71	3.73	21.0
1928	58	1 40	122	4.21	1 25	2900	9	24.5	0.90	0.74	3.88	20.7
1911	55	1 44	121	4.36	1 28	3000	10	24.8	0.92	0.78	4.03	20.5
1896	53	1 48	120	4.51	1 31	3100	10	25.0	0.94	0.81	4.18	20.2
1881	50	1 53	118	4.65	1 35	3200	11	25.2	0.97	0.85	4.34	20.0
1865	48	1 57	118	4.80	1 39	3300	11	25.5	1.00	0.89	4.50	19.7
1850	47	2 2	117	4.94	1 43	3400	11	25.7	1.03	0.93	4.66	19.5
1835	45	2 6	116	5.09	1 46	3500	12	26.0	1.06	0.98	4.82	19.3

RANGE TABLE for 9.2-inch B.L. Gun, Mark IX (Full Charge)—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for time and percussion, middle, No. 54, Marks I, II, or III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.		
f.s.	yards.	° ' "	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	secs.	inches.
1820	43	2 11	115	5.23	1 50	3600	12½	26.2	1.08	1.02	4.98	10.1
1805	41	2 16	114	5.38	1 54	3700	13	26.5	1.10	1.07	5.14	18.8
1792	40	2 21	113	5.52	1 58	3800	13½	26.8	1.13	1.12	5.30	18.6
1778	38	2 26	112	5.67	2 2	3900	13½	27.0	1.17	1.17	5.46	18.4
1764	37	2 31	111	5.81	2 6	4000	14½	27.3	1.20	1.22	5.62	18.2
1750	35	2 36	111	5.96	2 9	4100	14½	27.7	1.23	1.26	5.87	18.0
1737	33	2 41	110	6.11	2 13	4200	15	27.9	1.26	1.31	6.03	17.8
1724	33	2 46	110	6.25	2 17	4300	15½	28.2	1.27	1.38	6.10	17.6
1712	31	2 51	109	6.40	2 21	4400	16	28.5	1.30	1.41	6.27	17.4
1699	31	2 56	108	6.54	2 25	4500	16½	28.8	1.33	1.52	6.44	17.2
1685	30	3 2	108	6.69	2 29	4600	16½	29.2	1.36	1.58	6.60	17.0
1672	28	3 8	107	6.83	2 33	4700	17½	29.5	1.40	1.65	6.77	16.8
1658	28	3 14	107	6.98	2 37	4800	17½	29.8	1.43	1.73	6.94	16.6
1644	27	3 20	106	7.13	2 41	4900	18½	30.1	1.47	1.81	7.10	16.4
1631	26	3 26	105	7.27	2 45	5000	18½	30.4	1.50	1.90	7.27	16.2
1618	25	3 32	104	7.42	2 49	5100	19	30.8	1.54	2.00	7.45	16.1
1606	25	3 39	103	7.56	2 54	5200	19½	31.1	1.58	2.08	7.63	15.9
1594	24	3 45	102	7.71	2 58	5300	20	31.5	1.62	2.18	7.81	15.7
1581	23	3 52	101	7.85	3 2	5400	20½	31.8	1.66	2.29	7.99	15.5
1568	23	3 59	100	8.00	3 7	5500	21	32.2	1.70	2.39	8.17	15.3
1555	22	4 6	99	8.14	3 11	5600	21½	32.6	1.74	2.50	8.36	15.2
1542	22	4 13	98	8.29	3 16	5700	22	33.0	1.77	2.62	8.54	15.0
1529	21	4 21	97	8.43	3 20	5800	22½	33.4	1.80	2.74	8.72	14.9
1517	20	4 29	96	8.58	3 24	5900	23	33.8	1.84	2.86	8.90	14.8
1504	20	4 37	95	8.73	3 29	6000	23½	34.2	1.88	2.99	9.09	14.6
1492	20	4 45	93	8.87	3 34	6100	24	34.6	1.92	3.10	9.27	14.5
1480	20	4 54	92	9.01	3 39	6200	24½	35.0	1.96	3.23	9.46	14.4
1467	19	5 2	91	9.16	3 43	6300	25	35.4	2.01	3.37	9.65	14.2
1455	18	5 11	90	9.30	3 48	6400	25½	35.8	2.05	3.52	9.85	14.1
1444	17	5 20	89	9.45	3 54	6500	26½	36.3	2.09	3.68	10.05	14.0
1432	17	5 29	88	9.60	4 0	6600	26½	36.6	2.13	3.83	10.26	13.8
1419	16	5 39	87	9.74	4 5	6700	27	37.1	2.17	4.00	10.47	13.7
1407	16	5 49	86	9.89	4 10	6800	27½	37.6	2.21	4.16	10.68	13.6
1395	16	5 59	85	10.03	4 15	6900	28	38.0	2.25	4.34	10.88	13.5
1384	15	6 10	84	10.18	4 20	7000	28½	38.4	2.30	4.50	11.09	13.4
1373	15	6 21	83	10.32	4 26	7100	29	38.8	2.34	4.70	11.30	13.3
1362	15	6 32	82	10.46	4 32	7200	29½	39.3	2.38	4.89	11.51	13.2
1352	15	6 43	81	10.60	4 37	7300	30	39.6	2.42	5.08	11.72	13.0
1340	15	6 55	80	10.75	4 43	7400	...	40.1	2.46	5.28	11.94	12.9
1330	14	7 7	79	10.89	4 49	7500	...	40.7	2.51	5.47	12.16	12.8
1320	14	7 19	78	11.04	4 55	7600	...	41.2	2.55	5.68	12.39	12.7
1309	13	7 31	77	11.19	5 1	7700	...	41.7	2.59	5.90	12.63	12.6
1298	11	7 44	76	11.34	5 8	7800	...	42.2	2.63	6.14	12.86	12.5
1288	11	7 57	75	11.48	5 14	7900	...	42.7	2.66	6.38	13.10	12.4
1279	11	8 10	74	11.63	5 20	8000	...	43.2	2.70	6.62	13.33	12.3
1270	11	8 23	73	11.77	5 27	8100	...	43.7	2.74	6.89	13.58	12.2
1260	11	8 37	72	11.92	5 33	8200	...	44.3	2.78	7.15	13.83	12.1
1250	11	8 51	71	12.07	5 39	8300	...	44.8	2.82	7.43	14.07	12.0
1242	10	9 5	71	12.22	5 46	8400	...	45.4	2.86	7.71	14.32	11.9
1233	10	9 20	70	12.36	5 54	8500	...	45.9	2.90	8.00	14.57	11.8
1223	10	9 35	70	12.51	6 1	8600	...	46.5	2.95	8.30	14.82	11.7
1213	10	9 50	69	12.65	6 8	8700	...	47.0	3.00	8.62	15.07	11.6
1201	10	10 6	68	12.80	6 15	8800	...	47.6	3.05	8.94	15.32	11.5
1194	9	10 22	67	12.94	6 22	8900	...	48.2	3.11	9.27	15.57	11.4
1185	9	10 38	67	13.09	6 29	9000	...	48.8	3.17	9.62	15.82	11.3
1176	9	10 54	66	13.24	6 36	9100	...	49.3	3.23	9.95	16.07	11.2
1167	8	11 11	65	13.38	6 44	9200	...	49.8	3.30	10.30	16.32	11.1
1159	8	11 28	64	13.53	6 51	9300	...	50.4	3.37	10.68	16.58	11.1
1150	8	11 45	64	13.67	6 59	9400	...	51.0	3.44	11.05	16.84	11.0
1142	8	12 2	63	13.81	7 7	9500	...	51.6	3.52	11.44	17.10	11.0

RANGE TABLE for 9.2-inch B.L. Gun, Mark IX (Full Charge)—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for time and pressure, middle, No. 5, Marks I, II, or III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.		
f.s.	yards.	° /	yards.	yards.	° /	yards.		yards.	yards.	yards.	secs.	inches.
1134	8	12 20	63	13.06	7 14	9600	...	52.2	3.61	11.81	17.37	10.9
1126	7	12 38	62	14.11	7 22	9700	...	52.8	3.70	12.23	17.61	10.8
1118	7	12 56	61	14.26	7 30	9800	...	52.3	3.79	12.63	17.90	10.7
1110	7	13 14	60	14.40	7 38	9900	...	53.0	3.89	13.05	18.17	10.5
1102	7	13 32	59	14.55	7 46	10000	...	54.5	4.00	13.45	18.45	10.4
1096	7	13 50	58	14.69	7 55	10100	...	55.0	4.10	13.87	18.73	10.4
1089	7	14 9	57	14.84	8 4	10200	...	55.6	4.22	14.28	19.00	10.3
1082	7	14 27	56	14.98	8 12	10300	...	56.2	4.34	14.70	19.28	10.2
1075	6	14 46	55	15.13	8 21	10400	...	56.8	4.46	15.12	19.57	10.2
1069	6	15 5	55	15.27	8 30	10500	...	57.3	4.58	15.55	19.87	10.1
1063	6	15 21	54	15.42	8 39	10600	...	58.0	4.70	16.00	20.17	10.0
1057	6	15 44	53	15.56	8 48	10700	...	58.6	4.83	16.43	20.46	10.0
1051	6	16 4	53	15.71	8 58	10800	...	59.2	4.97	16.87	20.75	9.9
1045	5	16 24	52	15.86	9 7	10900	...	59.8	5.12	17.32	21.04	9.8
1039	5	16 45	51	16.00	9 16	11000	...	60.3	5.27	17.77	21.34	9.8
1034	5	17 6	50	16.15	9 26	11100	...	60.8	5.42	18.24	21.65	9.7
1029	5	17 27	49	16.29	9 36	11200	...	61.5	5.58	18.70	21.96	9.7
1024	5	17 48	48	16.43	9 45	11300	...	62.2	5.76	19.27	22.27	9.6
1019	5	18 10	47	16.58	9 55	11400	...	62.8	5.92	19.83	22.59	9.6
1014	5	18 32	46	16.73	10 6	11500	...	63.4	6.10	20.43	22.90	9.5
1009	5	18 54	45	16.88	10 15	11600	...	64.0	6.27	20.90	23.21	9.5
1004	5	19 16	44	17.02	10 26	11700	...	64.6	6.45	21.47	23.52	9.4
1000	5	19 39	44	17.17	10 36	11800	...	65.2	6.64	21.57	23.83	9.3
995	4	20 2	44	17.31	10 47	11900	...	65.8	6.83	22.07	24.14	9.3
990	4	20 25	43	17.46	10 58	12000	...	66.5	7.03	22.57	24.44	9.2
986	4	20 48	43	17.60	11 9	12100	...	67.1	7.23	23.08	24.75	9.2
981	4	21 12	43	17.75	11 20	12200	...	67.7	7.42	23.57	25.06	9.2
977	4	21 36	42	17.90	11 31	12300	...	68.3	7.62	24.05	25.37	9.1
973	4	22 1	42	18.04	11 43	12400	...	69.0	7.83	24.56	25.69	9.0
969	4	22 26	41	18.18	11 55	12500	...	69.6	8.05	25.09	26.00	9.0
965	4	22 51	40	18.33	12 6	12600	...	70.2	8.26	25.60	26.31	8.9
961	4	23 16	39	18.47	12 18	12700	...	70.8	8.50	26.13	26.63	8.9
957	4	23 42	38	18.62	12 31	12800	...	71.5	8.74	26.65	26.95	8.8
953	3	24 8	38	18.76	12 44	12900	...	72.0	9.00	27.18	27.27	8.8
949	3	24 34	37	18.90	12 57	13000	...	72.6	9.25	27.70	27.59	8.7
946	3	25 0	37	19.05	13 10	13100	...	73.3	9.50	28.20	27.91	8.7
943	3	25 27	36	19.20	13 23	13200	...	73.8	9.76	28.80	28.23	8.7
939	3	25 54	36	19.34	13 36	13300	...	74.5	10.00	29.27	28.55	8.6
936	3	26 21	35	19.49	13 50	13400	...	75.1	10.28	29.80	28.87	8.6
933	3	26 48	35	19.63	14 4	13500	...	75.7	10.55	30.37	29.18	8.5
929	3	27 16	35	19.78	14 18	13600	...	76.4	10.82	30.90	29.50	8.5
924	3	27 44	34	19.93	14 32	13700	...	77.1	11.12	31.45	29.81	8.4
919	3	28 12	34	20.07	14 46	13800	...	77.7	11.40	32.00	30.20	8.4

The proportional resistance to penetration of wrought-iron, compound or mild steel, and Harveyed armour, may be taken roughly as 1 : 1½ : 2.

A 9.2-inch common shell, with a velocity of about 2,000 f.s., may be expected to perforate about 6 inches of Harveyed armour, if struck direct; or about 5 inches at 30° to the normal.

Under similar circumstances, a 9.2-inch armour-piercing shell may be expected to perforate about 9 inches and 7 inches Harveyed armour, and it would probably perforate 9 inches of compound or mild steel armour if struck direct or at an angle of 30° to the normal.



# RANGE TABLE for 9.2-inch B.L. Gun, Mark IX (three-quarter charge).

Based on Practice of 5.12.98.

4918  
8877

Minute 46,518 III.

Charge, { weight, 75 lb.  
gravimetric density,  $\frac{108.0}{0.257}$   
nature, cordite, size 44.

Muzzle velocity, 2127 f.s.

Nature of mounting barbette, Mark IV.

Projectile, { nature, common shell, filled.  
weight, 380 lb.

Jump, + 3 minutes.  
Corrected for gun on same level as target.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	FUZE scale for time and percussion, middle, No. 54, Marks I, II, III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.	
f.s.	yards.	° /	yards.	yards.	° /	yards.		yards.	yards.	yards.	secs.
2111	955	0 4	125	0.14	0 0	100		...	...	...	0.14
2090	520	0 9	125	0.29	0 4	200		...	...	...	0.28
2068	358	0 13	124	0.43	0 8	300	1 1/2	...	...	...	0.42
2046	273	0 18	123	0.58	0 12	400	1 3/4	...	...	...	0.56
2026	223	0 22	122	0.72	0 16	500	2 1/4	...	...	...	0.71
2006	191	0 27	121	0.87	0 20	600	2 1/2	9	0.5	0.08	0.86
1986	163	0 31	120	1.01	0 24	700	2 3/4	10	0.5	0.10	1.01
1966	143	0 36	119	1.16	0 28	800	3 1/4	11	0.6	0.11	1.16
1948	127	0 41	118	1.31	0 32	900	3 1/2	11	0.6	0.14	1.31
1930	115	0 46	117	1.45	0 36	1000	4	12	0.6	0.17	1.47
1911	103	0 51	116	1.60	0 40	1100	4 1/4	12	0.7	0.20	1.63
1893	95	0 56	115	1.74	0 44	1200	4 1/2	13	0.7	0.22	1.80
1875	87	1 1	113	1.89	0 48	1300	5	13	0.7	0.25	1.97
1857	80	1 6	112	2.03	0 52	1400	5 1/2	14	0.8	0.29	2.14
1841	75	1 11	110	2.18	0 56	1500	6	14	0.8	0.32	2.31
1825	70	1 17	109	2.32	1 0	1600	6 1/4	15	0.8	0.36	2.48
1809	65	1 22	107	2.47	1 4	1700	6 1/2	16	0.9	0.40	2.65
1793	61	1 28	106	2.61	1 8	1800	7	17	0.9	0.44	2.82
1777	59	1 33	104	2.76	1 12	1900	7 1/2	18	0.9	0.50	2.98
1761	55	1 39	102	2.91	1 16	2000	8	19	0.9	0.57	3.15
1746	51	1 45	100	3.05	1 20	2100	8 1/4	19	1.0	0.63	3.32
1731	48	1 51	99	3.20	1 25	2200	8 1/2	20	1.0	0.69	3.50
1716	45	1 57	98	3.34	1 30	2300	9	21	1.1	0.75	3.67
1702	43	2 4	96	3.49	1 35	2400	9 1/4	21	1.1	0.81	3.85
1687	41	2 11	95	3.63	1 40	2500	10	22	1.1	0.88	4.02
1672	40	2 18	93	3.78	1 46	2600	10 1/2	23	1.2	0.95	4.19
1658	38	2 25	92	3.92	1 51	2700	11	23	1.2	1.02	4.37
1645	37	2 32	91	4.07	1 57	2800	11 1/4	24	1.2	1.10	4.55
1631	35	2 39	90	4.21	2 2	2900	11 1/2	24	1.3	1.17	4.73
1617	33	2 47	89	4.36	2 8	3000	12 1/4	25	1.3	1.25	4.92
1603	31	2 54	87	4.51	2 13	3100	12 1/2	25	1.3	1.28	5.11
1590	31	3 2	86	4.65	2 18	3200	13 1/4	26	1.4	1.30	5.30
1576	30	3 9	85	4.80	2 23	3300	13 1/2	27	1.4	1.45	5.48
1563	28	3 17	83	4.94	2 28	3400	14	28	1.4	1.60	5.66
1550	27	3 25	82	5.09	2 33	3500	14 1/2	28	1.4	1.70	5.85
1537	27	3 33	81	5.23	2 39	3600	15 1/4	29	1.5	1.80	6.05
1524	26	3 41	80	5.38	2 44	3700	15 1/2	29	1.5	1.90	6.24
1511	25	3 50	78	5.52	2 50	3800	16 1/4	30	1.5	2.0	6.44
1499	25	3 58	77	5.67	2 56	3900	16 1/2	30	1.6	2.1	6.64
1487	24	4 7	76	5.81	3 2	4000	17 1/4	31	1.6	2.2	6.85

RANGE TABLE for 9.2-inch B.L. Gun, Mark IX ( $\frac{3}{4}$  Charge)—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for time and percussion, middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.	
f.s.	yards.	° /	yards.	yards.	° /	yards.		yards.	yards.	yards.	secs.
1475	23	4 16	75	5.96	3 8	4100	172	31	1.6	2.3	7.05
1461	22	4 25	74	6.11	3 11	4200	181	32	1.6	2.1	7.26
1455	21	4 34	73	6.25	3 20	4300	182	32	1.7	2.5	7.46
1442	20	4 44	73	6.40	3 26	4400	193	33	1.7	2.6	7.67
1431	20	4 54	72	6.54	3 32	4500	20	33	1.7	2.8	7.88
1420	19	5 4	71	6.69	3 38	4600	204	34	1.7	3.0	8.09
1409	18	5 14	71	6.83	3 44	4700	21	34	1.8	3.1	8.29
1398	18	5 21	70	6.98	3 51	4800	214	35	1.8	3.2	8.50
1387	17	5 31	69	7.13	3 57	4900	224	35	1.8	3.4	8.72
1376	17	5 45	69	7.27	4 3	5000	222	36	1.8	3.6	8.94
1365	16	5 55	68	7.42	4 9	5100	234	36	1.9	3.8	9.15
1355	15	6 6	68	7.56	4 16	5200	24	37	1.9	4.0	9.37
1343	15	6 17	67	7.71	4 23	5300	244	37	1.9	4.1	9.58
1332	15	6 28	67	7.85	4 30	5400	25	38	1.9	4.2	9.80
1321	14	6 40	66	8.00	4 36	5500	254	38	2.0	4.3	10.02
1310	14	6 52	66	8.14	4 43	5600	261	39	2.0	4.4	10.24
1297	13	7 4	65	8.29	4 49	5700	262	39	2.0	4.6	10.46
1285	13	7 17	65	8.43	4 56	5800	274	39	2.0	4.9	10.68
1274	13	7 29	64	8.58	5 2	5900	28	39	2.0	5.2	10.90
1264	12	7 42	64	8.73	5 9	6000	284	40	2.1	5.1	11.13
1253	12	7 55	63	8.87	5 16	6100	294	40	2.1	5.6	11.36
1243	11	8 8	63	9.01	5 24	6200	294	40	2.1	5.7	11.60
1233	11	8 21	62	9.16	5 31	6300	...	40	2.1	5.8	11.82
1223	11	8 35	62	9.30	5 39	6400	...	41	2.2	5.9	12.08
1213	10	8 48	61	9.45	5 47	6500	...	41	2.2	6.2	12.33
1203	10	9 2	61	9.60	5 55	6600	...	41	2.2	6.5	12.58
1194	10	9 16	60	9.74	6 3	6700	...	41	2.2	6.8	12.83
1185	10	9 30	60	9.89	6 10	6800	...	41	2.2	7.2	13.08
1176	9	9 44	59	10.03	6 18	6900	...	41	2.3	7.5	13.34
1168	9	9 59	59	10.18	6 27	7000	...	41	2.3	7.8	13.60
1160	9	10 14	58	10.32	6 35	7100	...	41	2.3	8.1	13.85
1152	8	10 29	58	10.46	6 43	7200	...	42	2.3	8.4	14.10
1144	8	10 41	57	10.60	6 51	7300	...	42	2.3	8.6	14.35
1137	8	11 0	57	10.75	6 59	7400	...	42	2.4	8.9	14.60
1130	8	11 16	56	10.89	7 7	7500	...	42	2.4	9.1	14.86
1124	8	11 32	55	11.04	7 16	7600	...	42	2.4	9.4	15.13
1117	8	11 48	55	11.19	7 25	7700	...	42	2.4	9.6	15.39
1110	8	12 5	54	11.34	7 34	7800	...	42	2.4	9.9	15.66
1103	7	12 22	54	11.48	7 42	7900	...	42	2.5	10.2	15.91
1096	7	12 40	54	11.63	7 51	8000	...	42	2.5	10.5	16.17
1089	7	12 57	53	11.77	8 0	8100	...	42	2.5	10.6	16.43
1083	7	13 15	53	11.92	8 9	8200	...	42	2.5	10.7	16.70
1076	7	13 33	53	12.07	8 18	8300	...	41	2.5	10.6	16.97
1070	7	13 51	52	12.22	8 28	8400	...	41	2.5	10.5	17.24
1064	7	14 9	52	12.36	8 37	8500	...	41	2.6	10.4	17.51
1058	7	14 28	52	12.51	8 46	8600	...	41	2.6	10.3	17.78
1053	6	14 47	51	12.65	8 55	8700	...	41	2.6	10.2	18.06
1048	6	15 6	51	12.80	9 5	8800	...	40	2.6	10.2	18.34
1042	6	15 25	50	12.94	9 15	8900	...	40	2.6	10.4	18.62
1039	6	15 45	50	13.09	9 25	9000	...	40	2.6	10.6	18.90
1030	6	16 5	50	13.24	9 35	9100	...	40	2.7	10.8	19.18
1025	6	16 25	50	13.38	9 45	9200	...	39	2.7	11.0	19.46
1020	6	16 45	49	13.53	9 55	9300	...	39	2.7	11.2	19.74
1015	5	17 6	49	13.67	10 6	9400	...	39	2.7	11.4	20.03
1010	5	17 27	48	13.81	10 17	9500	...	38	2.7	11.5	20.33
1005	5	17 49	48	13.96	10 28	9600	...	38	2.7	11.6	20.63
1000	5	18 11	48	14.11	10 39	9700	...	38	2.7	11.7	20.91
995	5	18 33	47	14.26	10 50	9800	...	37	2.7	11.8	21.20
990	5	18 55	47	14.40	11 0	9900	...	37	2.8	11.9	21.49
985	5	19 18	47	14.55	11 11	10000	...	36	2.8	12.0	21.78

RANGE TABLE for 9.2-inch B.L. Gun, Mark IX ( $\frac{3}{4}$  Charge)—*continued*.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuzescale for time and percussion, middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.	
f.s.	yards.	° ' "	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	secs.
981	5	19 41	46	14.69	11 23	10100	...	36	2.8	12.0	22.06
977	4	20 4	46	14.84	11 35	10200	...	35	2.8	12.3	22.34
972	4	20 27	45	14.98	11 47	10300	...	35	2.8	12.6	22.62
968	4	20 50	45	15.13	12 0	10400	...	35	2.8	12.9	22.90
964	4	21 13	44	15.27	12 13	10500	...	34	2.8	13.2	23.18
960	4	21 37	43	15.42	12 26	10600	...	34	2.8	13.5	23.46
955	4	22 1	42	15.56	12 39	10700	...	33	2.8	13.8	23.74
950	4	22 25	41	15.71	12 52	10800	...	33	2.9	14.1	24.03
946	4	22 49	40	15.86	13 5	10900	...	32	2.9	14.4	24.31
942	3	23 14	39	16.00	13 19	11000	...	32	2.9	14.7	24.60
938	3	23 39	38	16.15	13 32	11100	...	31	2.9	15.0	24.89
934	3	24 4	37	16.29	13 45	11200	...	31	2.9	15.2	25.18
929	3	24 29	36	16.43	13 59	11300	...	31	2.9	15.5	25.47
925	3	24 55	35	16.58	14 13	11400	...	30	2.9	15.7	25.75
920	3	25 21	35	16.73	14 26	11500	...	30	2.9	15.9	26.04
915	3	25 47	34	16.88	14 40	11600	...	29	2.9	16.1	26.34
910	3	26 13	34	17.02	14 53	11700	...	29	3.0	16.3	26.63
905	3	...	33	17.17	15 0	11800	...	28	3.0	16.5	26.92

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X.  
(Composite, Full Charge.)

Based on Practice of 16.7.00.

40185  
9259

Minute 49,687 I.

40185  
9552

Charge, { weight, 103 lb.  
gravimetric density, 78.8  
nature { 99 lb. cordite, size 44; and  
4 " " 3 1/2.

Muzzle velocity, 2643 f.s.

Nature of mounting, barbette, Mark IV.

Projectile, { nature, cast steel, pointed, com-  
mon shell, Mark II.  
weight, 380 lb.

Jump, + 2 1/4 minutes.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	° ' "	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	seconds	ins.
2616	2864	0 3	232	0.14	0 1	100	...	...	...	...	0.11	32.56
2592	1146	0 5	230	0.29	0 4	200	...	...	...	...	0.23	32.12
2568	767	0 7	228	0.43	0 6	300	...	...	...	...	0.35	31.69
2544	572	0 10	226	0.58	0 9	400	...	...	...	...	0.47	31.26
2520	485	0 12	224	0.72	0 11	500	1	...	...	...	0.59	30.84
2496	382	0 15	222	0.87	0 14	600	1 1/2	20.5	0.25	0.15	0.71	30.43
2472	318	0 18	220	1.01	0 16	700	1 1/2	20.7	0.28	0.16	0.83	30.03
2448	274	0 21	218	1.16	0 19	800	2	20.8	0.31	0.17	0.95	29.63
2424	239	0 24	216	1.31	0 21	900	2 1/2	20.9	0.35	0.18	0.97	29.23
2400	212	0 27	214	1.45	0 24	1000	2 1/2	21.1	0.38	0.19	1.19	28.83
2377	191	0 30	212	1.60	0 26	1100	3	21.3	0.40	0.20	1.31	28.43
2354	173	0 33	210	1.74	0 29	1200	3 1/2	21.4	0.43	0.22	1.43	28.03
2332	159	0 36	208	1.89	0 31	1300	3 3/4	21.6	0.47	0.24	1.55	27.63
2310	145	0 40	206	2.03	0 34	1400	4	21.7	0.50	0.26	1.68	27.23
2288	134	0 43	204	2.18	0 36	1500	4 1/2	21.8	0.54	0.28	1.80	26.84
2267	125	0 46	202	2.32	0 39	1600	4 3/4	22.0	0.57	0.30	1.93	26.46
2246	117	0 49	200	2.47	0 41	1700	5	22.2	0.59	0.32	2.06	26.02
2225	109	0 53	198	2.61	0 44	1800	5 1/2	22.4	0.61	0.34	2.19	25.70
2205	102	0 56	196	2.76	0 47	1900	6 1/4	22.5	0.63	0.36	2.32	25.35
2185	97	0 59	194	2.91	0 50	2000	6 1/2	22.6	0.66	0.38	2.46	25.00
2165	92	1 2	192	3.05	0 53	2100	6 3/4	22.8	0.69	0.40	2.60	24.65
2146	89	1 5	190	3.20	0 56	2200	6 3/4	23.0	0.71	0.43	2.74	24.30
2127	84	1 8	188	3.34	0 59	2300	6 3/4	23.2	0.74	0.45	2.88	23.96
2108	79	1 12	186	3.49	1 2	2400	7 1/4	23.4	0.77	0.51	3.02	23.63
2090	75	1 16	184	3.63	1 4	2500	7 1/2	23.6	0.80	0.55	3.16	23.31
2072	71	1 20	182	3.78	1 8	2600	8	23.8	0.83	0.59	3.30	23.00
2055	68	1 24	180	3.92	1 11	2700	8 1/2	24.0	0.85	0.63	3.44	22.69
2038	65	1 28	178	4.07	1 13	2800	8 1/2	24.3	0.88	0.68	3.59	22.38
2031	62	1 32	176	4.21	1 17	2900	9	24.5	0.90	0.73	3.73	22.09
2004	59	1 36	174	4.36	1 21	3000	9 1/2	24.8	0.92	0.78	3.88	21.80
1988	57	1 40	172	4.51	1 24	3100	10	25.0	0.94	0.83	4.03	21.51
1972	55	1 44	170	4.65	1 28	3200	10 1/2	25.2	0.97	0.88	4.18	21.22
1956	53	1 48	168	4.80	1 31	3300	10 1/2	25.5	1.00	0.92	4.33	20.97
1940	51	1 52	166	4.94	1 35	3400	11	25.7	1.03	0.98	4.49	20.72
1925	49	1 56	164	5.09	1 38	3500	11 1/2	26.0	1.05	1.03	4.64	20.47
1910	48	2 0	162	5.23	1 42	3600	12	26.2	1.08	1.08	4.80	20.22
1895	46	2 4	160	5.38	1 45	3700	12 1/2	26.5	1.10	1.14	4.95	19.97
1880	44	2 9	158	5.52	1 49	3800	12 3/4	26.8	1.13	1.20	5.11	19.73
1865	43	2 13	156	5.67	1 53	3900	13 1/4	27.0	1.17	1.26	5.27	19.50
1850	41	2 18	154	5.81	1 56	4000	13 1/2	27.3	1.23	1.32	5.43	19.27

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	° ' "	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	seconds.	inches.
1836	40	2 23	152	5.96	1 59	4100	14	27.7	1.23	1.38	5.59	19.05
1822	39	2 28	150	6.11	2 3	4200	14½	27.9	1.26	1.45	5.75	18.84
1809	37	2 33	148	6.25	2 6	4300	14½	28.2	1.27	1.52	5.91	18.62
1796	36	2 38	146	6.40	2 10	4400	15½	28.5	1.30	1.59	6.07	18.41
1783	35	2 43	144	6.54	2 13	4500	15½	28.8	1.33	1.66	6.23	18.20
1770	34	2 49	142	6.69	2 17	4600	16	29.2	1.36	1.74	6.40	18.00
1757	33	2 54	140	6.83	2 21	4700	16½	29.5	1.40	1.82	6.56	17.81
1744	32	3 0	138	6.98	2 25	4800	17	29.8	1.43	1.90	6.73	17.62
1731	31	3 6	136	7.13	2 29	4900	17½	30.1	1.47	1.98	6.89	17.43
1718	30	3 11	134	7.27	2 33	5000	17½	30.4	1.50	2.06	7.06	17.25
1705	29	3 17	132	7.42	2 37	5100	18½	30.8	1.54	2.14	7.22	17.07
1692	28	3 23	130	7.56	2 41	5200	18½	31.1	1.58	2.22	7.39	16.89
1679	27	3 29	128	7.71	2 45	5300	19	31.5	1.62	2.30	7.55	16.71
1667	26	3 35	126	7.85	2 49	5400	19½	31.8	1.66	2.38	7.72	16.53
1655	26	3 41	124	8.00	2 53	5500	20	32.2	1.70	2.46	7.89	16.36
1643	25	3 48	122	8.14	2 57	5600	20½	32.6	1.74	2.54	8.06	16.20
1632	24	3 55	120	8.29	3 1	5700	20½	33.0	1.77	2.62	8.23	16.05
1621	23	4 2	118	8.43	3 6	5800	21½	33.4	1.80	2.70	8.41	15.90
1610	23	4 9	116	8.58	3 9	5900	21½	33.8	1.84	2.78	8.58	15.75
1600	22	4 16	114	8.73	3 13	6000	22½	34.2	1.88	2.86	8.76	15.60
1590	21	4 23	112	8.87	3 17	6100	22½	34.6	1.92	2.95	8.94	15.47
1580	21	4 30	111	9.01	3 22	6200	23½	35.0	1.96	3.05	9.12	15.34
1570	20	4 37	110	9.16	3 26	6300	23½	35.4	2.01	3.16	9.30	15.22
1560	20	4 45	109	9.30	3 31	6400	24	35.8	2.05	3.28	9.49	15.10
1550	19	4 53	108	9.45	3 35	6500	24½	36.3	2.09	3.40	9.68	14.99
1540	19	5 1	107	9.60	3 40	6600	25	36.6	2.13	3.52	9.88	14.88
1530	18	5 9	106	9.74	3 44	6700	25½	37.1	2.17	3.64	10.07	14.78
1520	18	5 18	105	9.89	3 49	6800	26	37.6	2.21	3.77	10.27	14.68
1510	17	5 27	104	10.04	3 54	6900	26½	38.0	2.25	3.91	10.46	14.58
1501	17	5 36	103	10.18	3 59	7000	27	38.4	2.30	4.06	10.66	14.48
1491	17	5 45	103	10.32	4 4	7100	27½	38.8	2.34	4.22	10.85	14.38
1482	16	5 54	101	10.46	4 9	7200	28	39.3	2.38	4.38	11.05	14.29
1472	16	6 3	100	10.60	4 14	7300	28½	39.6	2.42	4.54	11.24	14.20
1463	15	6 13	99	10.75	4 19	7400	29	40.1	2.46	4.70	11.44	14.11
1454	15	6 23	98	10.89	4 24	7500	29½	40.7	2.51	4.86	11.63	14.02
1445	14	6 33	97	11.04	4 30	7600	30	41.2	2.55	5.0	11.83	13.93
1436	14	6 43	96	11.19	4 35	7700	...	41.7	2.59	5.2	12.03	13.84
1427	14	6 54	95	11.34	4 41	7800	...	42.2	2.63	5.4	12.23	13.76
1418	13	7 4	94	11.48	4 47	7900	...	42.7	2.66	5.6	12.43	13.67
1409	13	7 15	93	11.63	4 53	8000	...	43.2	2.70	5.8	12.64	13.59
1400	13	7 26	92	11.77	4 59	8100	...	43.7	2.74	6.0	12.84	13.50
1391	12	7 37	91	11.92	5 5	8200	...	44.3	2.78	6.2	13.05	13.42
1382	12	7 48	90	12.07	5 11	8300	...	44.8	2.82	6.4	13.26	13.33
1374	12	8 0	89	12.22	5 17	8400	...	45.4	2.89	6.6	13.47	13.25
1365	12	8 12	88	12.36	5 23	8500	...	46.0	2.90	6.8	13.68	13.16
1357	11	8 24	87	12.51	5 29	8600	...	46.5	2.95	7.0	13.90	13.08
1349	11	8 46	86	12.65	5 35	8700	...	47.0	3.00	7.2	14.12	12.99
1340	11	8 49	85	12.80	5 41	8800	...	47.6	3.05	7.4	14.34	12.91
1332	10	9 3	84	12.94	5 47	8900	...	48.2	3.11	7.6	14.56	12.82
1324	10	9 15	83	13.09	5 53	9000	...	48.8	3.17	7.8	14.79	12.74
1316	10	9 28	82	13.24	5 59	9100	...	49.3	3.23	8.0	15.01	12.65
1308	10	9 42	81	13.38	6 6	9200	...	49.8	3.30	8.3	15.24	12.57
1300	10	9 56	80	13.53	6 12	9300	...	50.4	3.37	8.6	15.47	12.49
1292	9	10 10	79	13.67	6 19	9400	...	51.0	3.44	8.9	15.70	12.41
1284	9	10 24	78	13.81	6 25	9500	...	51.6	3.52	9.2	15.93	12.33
1276	9	10 38	77	13.96	6 32	9600	...	52.2	3.61	9.5	16.17	12.25
1268	9	10 52	77	14.11	6 38	9700	...	52.8	3.70	9.8	16.41	12.16
1261	8	11 7	76	14.26	6 45	9800	...	53.3	3.79	10.1	16.65	12.08
1253	8	11 22	75	14.40	6 51	9900	...	53.9	3.89	10.4	16.91	11.99
1246	8	11 37	74	14.55	6 58	10000	...	54.5	4.00	10.7	17.16	11.91

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 6, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	° ' "	yards.	yards.	° ' "	yards.	...	yards.	yards.	yards.	seconds.	inches.
1208	8	11 52	73	14 69	7 4	10100	...	55 0	4 10	11 0	17 41	11 82
1231	8	12 8	72	14 84	7 11	10200	...	55 6	4 22	11 3	17 66	11 74
1224	8	12 23	72	14 98	7 18	10300	...	56 2	4 44	11 6	17 91	11 68
1217	7	12 38	71	15 13	7 25	10400	...	56 8	4 46	11 9	18 16	11 58
1210	7	12 53	71	15 27	7 32	10500	...	57 3	4 58	12 3	18 41	11 50
1203	7	13 9	70	15 42	7 39	10600	...	58 0	4 70	13 7	18 67	11 42
1196	7	13 24	69	15 56	7 46	10700	...	58 6	4 83	13 1	18 93	11 34
1189	7	13 40	68	15 71	7 53	10800	...	59 2	4 97	13 5	19 19	11 27
1182	7	13 55	67	15 85	8 0	10900	...	59 8	5 12	13 9	19 45	11 19
1175	7	14 11	66	15 00	8 8	11000	...	60 3	5 27	14 3	19 72	11 12
1168	6	14 26	65	16 14	8 15	11100	...	60 8	5 42	14 7	19 99	11 05
1161	6	14 42	64	16 29	8 23	11200	...	61 5	5 58	15 1	20 26	10 98
1154	6	14 58	63	16 43	8 31	11300	...	62 2	5 76	15 5	20 54	10 91
1147	6	15 15	62	16 58	8 39	11400	...	62 8	5 92	15 9	20 82	10 84
1140	6	15 31	61	16 72	8 47	11500	...	63 4	6 10	16 3	21 10	10 77
1134	6	15 48	60	16 87	8 56	11600	...	64 0	6 27	16 7	21 39	10 70
1127	6	16 4	59	17 01	9 4	11700	...	64 6	6 45	17 1	21 68	10 63
1121	6	16 21	58	17 16	9 13	11800	...	65 2	6 64	17 5	21 98	10 56
1114	6	16 37	58	17 30	9 21	11900	...	65 8	6 83	17 9	22 28	10 49
1108	5	16 54	57	17 45	9 30	12000	...	66 5	7 03	18 3	22 58	10 42
1101	5	17 11	57	17 50	9 39	12100	...	67 1	7 23	18 7	22 88	10 35
1095	5	17 28	56	17 74	9 48	12200	...	67 7	7 42	19 1	23 18	10 28
1089	5	17 45	55	17 89	9 57	12300	...	68 3	7 62	19 5	23 48	10 21
1082	5	18 3	54	18 03	10 6	12400	...	69 0	7 83	19 9	23 78	10 15
1075	5	18 20	53	18 17	10 15	12500	...	69 6	8 05	20 3	24 08	10 08
1069	5	18 38	52	18 32	10 25	12600	...	70 2	8 26	20 7	24 39	10 02
1063	5	18 55	51	18 46	10 35	12700	...	70 8	8 50	21 1	24 69	9 95
1057	5	19 13	50	18 61	10 45	12800	...	71 5	8 74	21 5	25 00	9 89
1051	5	19 31	49	18 75	10 55	12900	...	72 0	9 00	21 9	25 31	9 82
1045	5	19 49	48	18 90	11 5	13000	...	72 6	9 25	22 3	25 62	9 76
1039	5	20 7	48	19 04	11 15	13100	...	73 3	9 50	22 7	25 94	9 69
1033	4	20 25	47	19 19	11 26	13200	...	73 8	9 75	23 1	26 26	9 63
1027	4	20 43	47	19 33	11 36	13300	...	74 5	10 00	23 5	26 58	9 56
1021	4	21 1	46	19 48	11 47	13400	...	75 1	10 28	23 9	26 91	9 50
1015	4	21 19	46	19 62	11 58	13500	...	75 7	10 55	24 3	27 24	9 43
1010	4	21 38	45	19 77	12 9	13600	...	76 4	10 82	24 7	27 57	9 37
994	4	21 56	45	19 91	12 20	13700	...	77 1	11 10	25 1	27 90	9 30
999	4	22 15	44	20 06	12 31	13800	...	77 7	11 40	25 5	28 24	9 24
993	4	22 32	44	20 20	12 42	13900	...	78 4	11 70	25 9	28 58	9 17
988	4	22 52	44	20 35	12 53	14000	...	79 0	12 00	26 3	28 92	9 11

The proportional resistance to penetration of wrought-iron, compound or mild steel and Harveyed armour, may be taken roughly as 1 : 1½ : 2.

A 9.2-inch common shell, with a velocity of about 2,000 f.s., may be expected to perforate about 6 inches of Harveyed armour, if struck direct, or about 5 inches at 30° to the normal.

Under similar circumstances, a 9.2-inch armour-piercing shell may be expected to perforate about 9 inches and 7 inches Harveyed armour, and it would probably perforate 9 inches of compound or mild steel if struck direct or at an angle of 30° to the normal.

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X  
(three-quarter composite charge).

Based on Practice of 30.7.00.

40185  
9552

Minute 49,756 III.

Charge,	{	weight, 77½ lb.	Muzzle velocity, 2196 f.s.
		gravimetric density, $\frac{106.7}{0.260}$ .	
		nature { 74½ lb. cordite, size	
		4½, and	Nature of mounting, barbette, Mark IV.
		3 lb. cordite, size 3½.	
Projectile,	{	nature, cast steel, pointed,	Jump, + 3 minutes.
		common shell, Mark II.	
		weight, 380 lb.	

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	Range.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I, II, and III.	50 per cent. of round* should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
f.s.	yards.	° /	yards.	yards.	° /	yards.		yards.	yards.	yards.	seconds.
2174	1432	0 4	142	0.14	0 1	100	1	...	...	...	0.14
2153	714	0 8	140	0.29	0 4	200	1	...	...	...	0.29
2131	477	0 12	138	0.43	0 8	300	1	...	...	...	0.43
2110	358	0 16	136	0.58	0 12	400	1	...	...	...	0.58
2088	286	0 20	134	0.72	0 16	500	1	...	...	...	0.73
2067	229	0 25	132	0.87	0 20	600	2	21.0	0.35	0.1	0.88
2046	197	0 29	130	1.01	0 24	700	2	21.4	0.37	0.1	1.03
2025	169	0 34	128	1.16	0 28	800	2	21.9	0.40	0.1	1.18
2002	151	0 38	126	1.31	0 32	900	3	22.3	0.42	0.1	1.33
1985	133	0 43	124	1.45	0 36	1000	3	22.8	0.45	0.1	1.48
1965	122	0 47	122	1.60	0 40	1100	4	23.2	0.47	0.1	1.63
1946	110	0 52	121	1.74	0 44	1200	4	23.7	0.50	0.1	1.78
1927	100	0 57	120	1.89	0 48	1300	4	24.1	0.52	0.2	1.93
1908	92	1 2	119	2.03	0 52	1400	5	24.6	0.55	0.2	2.09
1890	87	1 6	118	2.18	0 56	1500	5	25.0	0.57	0.3	2.24
1872	81	1 11	117	2.32	1 0	1600	6	25.5	0.60	0.3	2.40
1855	75	1 16	116	2.47	1 4	1700	6	25.9	0.63	0.4	2.56
1838	71	1 21	115	2.61	1 8	1800	6	26.4	0.66	0.4	2.72
1821	66	1 26	114	2.76	1 12	1900	7	26.8	0.69	0.5	2.88
1805	63	1 31	113	2.91	1 16	2000	7	27.3	0.72	0.5	3.04
1789	59	1 36	112	3.05	1 20	2100	8	27.7	0.76	0.6	3.20
1773	56	1 41	111	3.20	1 24	2200	8	28.2	0.80	0.6	3.37
1757	54	1 46	110	3.34	1 28	2300	8	28.7	0.84	0.7	3.53
1742	51	1 52	109	3.49	1 32	2400	9	29.2	0.88	0.8	3.70
1727	49	1 57	108	3.63	1 36	2500	9	29.7	0.92	0.9	3.86
1713	46	2 3	107	3.78	1 41	2600	10	30.2	0.96	1.0	4.03
1699	44	2 9	106	3.92	1 45	2700	10	30.7	1.00	1.1	4.20
1685	42	2 15	105	4.07	1 50	2800	11	31.2	1.04	1.2	4.37
1671	40	2 21	104	4.21	1 54	2900	11	31.7	1.08	1.3	4.54
1657	39	2 27	103	4.36	1 59	3000	11	32.3	1.12	1.4	4.71
1643	37	2 33	102	4.51	2 4	3100	12	32.8	1.16	1.5	4.88
1630	36	2 39	101	4.65	2 9	3200	12	33.4	1.20	1.6	5.05
1616	34	2 45	100	4.80	2 14	3300	13	34.0	1.24	1.7	5.22
1603	33	2 52	99	4.94	2 19	3400	13	34.6	1.28	1.8	5.40
1589	32	2 59	98	5.09	2 24	3500	14	35.2	1.33	1.9	5.58



RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
f.s.	yards.	° ' "	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	seconds.
1576	31	3 6	97	5 23	2 29	3600	14½	35 8	1 38	2 0	5 76
1563	29	3 13	96	5 38	2 34	3700	15	36 4	1 43	2 1	5 94
1550	28	3 21	95	5 52	2 40	3800	15½	37 0	1 48	2 2	6 12
1537	27	3 28	94	5 67	2 45	3900	16	37 6	1 53	2 3	6 30
1524	26	3 36	93	5 81	2 51	4000	16½	38 2	1 58	2 4	6 49
1411	25	3 44	92	5 96	2 56	4100	17	38 8	1 63	2 6	6 68
1499	24	3 52	91	6 11	3 2	4200	17½	39 4	1 68	2 8	6 87
1486	24	4 0	90	6 25	3 7	4300	18	40 0	1 73	3 0	7 06
1474	23	4 9	89	6 40	3 13	4400	18½	40 6	1 78	3 2	7 26
1461	22	4 17	88	6 54	3 18	4500	19	41 3	1 83	3 4	7 46
1449	22	4 26	87	6 69	3 24	4600	19½	42 0	1 88	3 6	7 66
1436	21	4 35	86	6 83	3 30	4700	20	42 7	1 93	3 8	7 86
1424	20	4 44	85	6 98	3 36	4800	20½	43 4	1 99	4 0	8 07
1412	19	4 53	84	7 13	3 42	4900	21	44 1	2 04	4 2	8 27
1400	19	5 3	83	7 27	3 48	5000	21½	44 9	2 10	4 4	8 48
1388	18	5 13	82	7 42	3 54	5100	22	45 4	2 15	4 6	8 69
1376	18	5 23	81	7 56	4 0	5200	22½	46 6	2 21	4 8	8 90
1364	17	5 33	80	7 71	4 6	5300	23	47 1	2 26	5 0	9 11
1353	17	5 43	79	7 85	4 12	5400	23½	47 9	2 32	5 2	9 33
1341	16	5 53	78	8 00	4 18	5500	24	48 6	2 37	5 4	9 54
1330	16	6 4	77	8 14	4 24	5600	25	49 4	2 43	5 6	9 76
1319	15	6 15	76	8 29	4 30	5700	25½	50 2	2 49	5 9	9 98
1308	15	6 26	75	8 43	4 37	5800	26	51 0	2 55	6 2	10 20
1297	14	6 27	74	8 58	4 43	5900	26½	51 9	2 61	6 5	10 52
1287	14	6 43	73	8 73	4 50	6000	27	52 8	2 67	6 8	10 65
1276	13	6 50	72	8 87	4 57	6100	27½	53 7	2 73	7 1	10 88
1266	13	7 11	71	9 01	5 4	6200	28	54 6	2 80	7 4	11 11
1256	13	7 22	70	9 16	5 11	6300	29	55 5	2 86	7 8	11 34
1246	12	7 34	69	9 30	5 18	6400	29½	56 4	2 93	8 1	11 58
1236	12	7 46	68	9 45	5 25	6500	...	57 3	2 99	8 5	11 81
1227	12	7 58	67	9 60	5 32	6600	...	58 3	3 06	8 8	12 05
1218	11	8 9	66	9 74	5 39	6700	...	59 2	3 12	9 2	12 29
1209	11	8 21	65	9 89	5 47	6800	...	60 2	3 19	9 6	12 53
1200	11	8 33	64	10 03	5 54	6900	...	61 2	3 25	10 0	12 77
1192	11	8 45	63	10 18	6 2	7000	...	62 2	3 32	10 4	13 02
1184	10	8 67	63	10 32	6 10	7100	...	63 3	3 38	10 8	13 26
1176	10	9 10	62	10 46	6 18	7200	...	64 4	3 45	11 2	13 51
1168	10	9 23	62	10 60	6 26	7300	...	65 5	3 51	11 6	13 75
1161	9	9 36	61	10 75	6 34	7400	...	66 7	3 58	12 1	14 00
1154	9	9 49	61	10 89	6 42	7500	...	67 8	3 64	12 6	14 24
1147	9	10 3	60	11 04	6 50	7600	...	69 0	3 71	13 1	14 49
1140	9	10 17	60	11 19	6 58	7700	...	70 02	3 77	13 6	14 74
1133	9	10 31	59	11 34	7 6	7800	...	71 4	3 84	14 2	14 99
1126	8	10 45	59	11 48	7 14	7900	...	72 6	3 90	14 8	15 24
1119	8	11 0	58	11 63	7 23	8000	...	73 8	3 97	15 4	15 49
1112	8	11 15	58	11 77	7 31	8100	...	75 0	4 04	15 0	15 74
1106	8	11 30	57	11 92	7 40	8200	...	76 3	4 11	16 6	16 00
1100	8	11 45	57	12 07	7 48	8300	...	77 6	4 18	16 2	16 25
1094	7	12 1	56	12 22	7 57	8400	...	78 9	4 25	16 8	16 51
1088	7	12 17	56	12 36	8 6	8500	...	80 2	4 32	16 4	16 76
1082	7	12 33	55	12 51	8 15	8600	...	81 6	4 39	19 0	17 02
1076	7	12 49	55	12 65	8 24	8700	...	83 0	4 46	19 6	17 28
1070	7	13 6	54	12 80	8 31	8800	...	84 4	4 53	20 3	17 54
1064	7	13 22	54	12 94	8 43	8900	...	85 8	4 60	21 0	17 80
1059	6	13 39	53	13 09	8 53	9000	...	87 2	4 68	21 7	18 07
1053	6	13 56	53	13 24	9 2	9100	...	88 6	4 75	22 4	18 34
1048	6	14 13	52	13 38	9 12	9200	...	90 0	4 83	23 1	18 61
1042	6	14 30	52	13 53	9 22	9300	...	91 4	4 91	23 8	18 89
1037	6	14 48	51	13 67	9 32	9400	...	92 8	4 99	24 6	19 17
1032	6	15 6	51	13 81	9 42	9500	...	94 2	5 07	25 4	19 45

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X—continued.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
f.s.	yards.	° /	yards.	yards.	° /	yards		yards.	yards.	yards.	seconds.
1027	6	15 24	50	13.96	9 52	9600	...	95.7	5.15	26.3	19.74
1022	6	15 42	60	14.11	10 2	9700	...	97.2	5.23	27.1	20.03
1018	5	16 0	49	14.26	10 12	9800	...	98.8	5.31	28.0	20.32
1013	5	16 18	49	14.40	10 22	9900	...	100.3	5.39	28.9	20.61
1009	5	16 57	48	14.55	10 32	10000	...	101.9	5.47	29.9	20.91
1004	5	16 54	48	14.69	10 32	10100	...	103.5	5.55	30.9	21.21
1000	5	17 14	47	14.84	10 53	10200	...	105.1	5.64	32.0	21.51
996	5	17 33	47	14.98	11 3	10300	...	106.7	5.73	33.0	21.81
992	5	17 52	46	15.13	11 14	10400	...	108.3	5.82	34.1	22.12
988	5	18 11	46	15.27	11 25	10500	...	109.9	5.91	35.1	22.43
985	5	18 30	45	15.42	11 36	10600	...	111.5	6.01	36.2	22.74
982	4	18 49	45	15.56	11 47	10700	...	113.1	6.11	37.2	23.05
979	4	19 9	44	15.71	11 58	10800	...	114.7	6.21	38.3	23.36
976	4	19 28	44	15.85	12 9	10900	...	116.3	6.31	39.4	23.67
974	4	19 48	43	16.00	12 21	11000	...	117.9	6.41	40.5	23.99
972	4	20 8	43	16.14	12 32	11100	...	119.5	6.51	41.6	24.31
970	4	20 24	42	16.29	12 44	11200	...	121.1	6.61	42.7	24.63
968	4	20 48	42	16.43	12 55	11300	...	122.7	6.71	43.8	24.95
966	4	21 9	41	16.58	13 7	11400	...	124.3	6.81	45.0	25.28
964	4	21 29	41	16.72	13 19	11500	...	125.9	6.91	46.1	25.60
962	4	21 50	40	16.87	13 31	11600	...	127.5	7.01	47.3	25.98
960	4	22 10	40	17.01	13 43	11700	...	129.1	7.11	48.5	26.26
958	4	22 31	39	17.16	13 55	11800	...	130.7	7.21	49.7	26.59
956	4	22 51	39	17.30	14 7	11900	...	132.3	7.31	50.9	26.92
954	3	23 12	39	17.45	14 19	12000	...	133.9	7.41	52.1	27.26

The proportional resistance to penetration of wrought-iron, compound or mild steel, and Harveyed armour, may be taken roughly as 1 : 1½ : 2.

A 9.2-inch common shell, with a velocity of about 2,000 f.s., may be expected to perforate about 6 inches of Harveyed armour, if struck direct, or about 5 inches at 30° to the normal.

Under similar circumstances, a 9.2-inch armour-piercing shell may be expected to perforate about 9 inches and 7 inches Harveyed armour, and it would probably perforate 9 inches of compound or mild steel armour if struck direct or at an angle of 30° to the normal.

**RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X.  
(Composite Full Charge.)**

Based on Practice of 16,700 and 30,501.

*Minutes 43,041, 40,687 I, and 51,544 (a).*

40185	73
9552	3
	2844

Charge,	{	weight, 103 lb.	{	Muzzle velocity, 2043 f.s.
		gravimetric density, $\frac{78.8}{0.351}$ .		Nature of mounting, barbette, Mark V.
Projectile,	{	nature, 90 lb. cordite, size 4½; and 4 lb., size 3½.	{	Jump, + 1½ minutes.
		nature, cast steel, pointed, common shell, Mark II.		
		weight, 380 lb.		

Remaining velocity. (Actual.)	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	° /	yards.	yards.	° /	yards.		yards.	yards.	yards.	secs.	ins.
2619	2864	0 3	232	0.14	0 1	100	...	...	...	...	0.11	32.56
2596	1146	0 5	230	0.29	0 3	200	...	...	...	...	0.23	32.12
2572	767	0 7	228	0.43	0 6	300	...	...	...	...	0.35	31.69
2549	572	0 10	226	0.58	0 8	400	...	...	...	...	0.47	31.26
2526	485	0 12	234	0.72	0 11	500	1	...	...	...	0.59	30.84
2502	382	0 15	222	0.87	0 14	600	1½	20.5	0.25	0.15	0.71	30.43
2489	318	0 18	220	1.01	0 16	700	1½	20.4	0.28	0.16	0.83	30.03
2465	274	0 21	218	1.16	0 19	800	2	20.8	0.31	0.17	0.95	29.63
2432	230	0 24	216	1.31	0 21	900	2½	20.9	0.35	0.18	1.07	29.23
2409	212	0 27	214	1.45	0 24	1000	2½	21.1	0.38	0.19	1.19	28.83
2386	191	0 30	212	1.60	0 26	1100	3	21.3	0.40	0.20	1.31	28.43
2364	173	0 33	210	1.74	0 29	1200	3½	21.4	0.43	0.22	1.43	28.03
2342	159	0 36	208	1.89	0 32	1300	3½	21.6	0.47	0.24	1.55	27.63
2320	145	0 40	206	2.03	0 35	1400	4	21.7	0.50	0.26	1.63	27.23
2298	134	0 43	204	2.18	0 37	1500	4½	21.8	0.54	0.28	1.80	26.84
2277	125	0 46	202	2.32	0 40	1600	4½	22.0	0.57	0.30	1.93	26.46
2256	117	0 49	200	2.47	0 42	1700	5	22.2	0.59	0.32	2.06	26.02
2235	109	0 53	198	2.61	0 45	1800	5½	22.4	0.61	0.34	2.19	25.70
2215	102	0 56	196	2.76	0 48	1900	5½	22.5	0.63	0.36	2.32	25.35
2195	97	0 59	194	2.91	0 51	2000	5½	22.6	0.66	0.38	2.46	25.00
2175	92	1 2	192	3.05	0 54	2100	6½	22.8	0.69	0.40	2.60	24.65
2156	88	1 5	190	3.20	0 56	2200	6½	23.0	0.71	0.43	2.74	24.30
2137	84	1 8	188	3.34	1 0	2300	6½	23.2	0.74	0.48	2.88	23.95
2118	79	1 12	186	3.49	1 3	2400	7½	23.4	0.77	0.51	3.02	23.63
2099	75	1 16	184	3.63	1 6	2500	7½	23.6	0.80	0.56	3.16	23.31
2081	71	1 20	182	3.78	1 9	2600	8	23.8	0.83	0.59	3.30	23.00
2053	68	1 24	180	3.92	1 12	2700	8½	24.0	0.85	0.63	3.44	22.69
2046	65	1 28	178	4.07	1 15	2800	8½	24.3	0.88	0.68	3.59	22.38
2029	62	1 32	176	4.21	1 18	2900	9	24.5	0.90	0.73	3.73	22.09
2012	59	1 36	174	4.36	1 22	3000	9½	24.8	0.92	0.78	3.88	21.80
1995	57	1 40	172	4.51	1 25	3100	10	25.0	0.94	0.83	4.03	21.51
1979	55	1 44	170	4.65	1 29	3200	10½	25.2	0.97	0.88	4.18	21.22
1963	53	1 48	168	4.80	1 32	3300	10½	25.5	1.00	0.93	4.33	20.97
1948	51	1 52	166	4.94	1 36	3400	11	25.7	1.03	0.98	4.49	20.72
1933	49	1 56	164	5.09	1 39	3500	11½	26.0	1.05	1.03	4.64	20.47
1919	48	2 0	162	5.23	1 43	3600	12	26.2	1.08	1.08	4.80	20.22
1904	46	2 4	160	5.38	1 46	3700	12½	26.5	1.10	1.14	4.95	19.97
1890	44	2 9	158	5.52	1 50	3800	12½	26.8	1.13	1.20	5.11	19.73
1876	43	2 13	156	5.67	1 53	3900	13	27.0	1.17	1.26	5.27	19.50
1862	41	2 18	154	5.81	1 57	4000	13½	27.3	1.20	1.32	5.43	19.27

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X—continued.

Remaining velocity. (Actual).	To strike an object 10 feet high range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	°	yards.	yards.	°	yards.		yards.	yards.	yards.	secs.	ins.
1849	40	2 23	152	5.96	2 0	4100	14	27.7	1.23	1.38	5.59	19.05
1836	39	2 28	150	6.11	2 4	4200	14½	27.9	1.26	1.45	5.75	18.84
1823	37	2 33	148	6.25	3 7	4300	14½	28.2	1.27	1.52	5.91	18.62
1811	36	2 38	146	6.40	3 11	4400	15½	28.5	1.30	1.59	6.07	18.41
1799	35	2 43	144	6.54	3 14	4500	15½	28.8	1.33	1.66	6.23	18.20
1787	34	2 49	142	6.69	3 18	4600	16	29.2	1.36	1.74	6.40	18.00
1775	33	2 54	140	6.83	3 22	4700	16½	29.5	1.40	1.82	6.56	17.81
1764	32	3 0	138	6.98	3 26	4800	17	29.8	1.43	1.90	6.73	17.62
1752	31	3 5	136	7.13	3 30	4900	17½	30.1	1.47	1.98	6.89	17.43
1740	30	3 11	134	7.27	3 34	5000	17½	30.4	1.50	2.06	7.06	17.25
1730	29	3 17	132	7.42	3 38	5100	18½	30.8	1.54	2.14	7.22	17.07
1719	28	3 23	130	7.56	3 42	5200	18½	31.1	1.58	2.22	7.39	16.89
1708	27	3 29	128	7.71	3 46	5300	19	31.5	1.62	2.30	7.55	16.71
1697	26	3 35	126	7.85	3 50	5400	19½	31.8	1.66	2.38	7.72	16.53
1686	26	3 41	124	8.00	3 54	5500	20	32.2	1.70	2.46	7.89	16.36
1676	25	3 48	122	8.14	3 58	5600	20½	32.6	1.74	2.54	8.06	16.20
1666	24	3 55	120	8.29	3 2	5700	20½	33.0	1.77	2.62	8.23	16.05
1656	23	4 2	118	8.43	3 6	5800	21½	33.4	1.80	2.70	8.41	15.90
1646	23	4 9	116	8.58	3 10	5900	21½	33.8	1.84	2.78	8.58	15.75
1637	22	4 16	114	8.73	3 14	6000	22½	34.2	1.88	2.86	8.76	15.60
1628	21	4 23	112	8.87	3 18	6100	22½	34.6	1.92	2.95	8.94	15.47
1619	21	4 30	111	9.01	3 23	6200	23½	35.0	1.96	3.05	9.12	15.34
1610	20	4 37	110	9.16	3 27	6300	23½	35.4	2.01	3.16	9.30	15.22
1601	20	4 45	109	9.30	3 32	6400	24	35.8	2.05	3.28	9.49	15.10
1592	19	4 53	108	9.45	3 36	6500	24½	36.3	2.09	3.40	9.68	14.99
1583	19	5 1	107	9.60	3 41	6600	25	36.6	2.13	3.52	9.88	14.88
1574	18	5 9	106	9.74	3 45	6700	25½	37.1	2.17	3.64	10.07	14.78
1565	18	5 18	105	9.89	3 50	6800	26	37.6	2.21	3.77	10.27	14.68
1546	17	5 27	104	10.03	3 55	6900	26½	38.0	2.25	3.91	10.46	14.58
1547	17	5 36	103	10.18	4 0	7000	27	38.4	2.30	4.06	10.66	14.48
1538	17	5 45	102	10.32	4 5	7100	27½	38.8	2.34	4.22	10.85	14.38
1530	16	5 54	101	10.46	4 10	7200	28	39.3	2.38	4.38	11.05	14.29
1521	16	6 3	100	10.60	4 15	7300	28½	39.6	2.42	4.54	11.24	14.20
1513	15	6 13	99	10.75	4 20	7400	29	40.1	2.46	4.70	11.44	14.11
1504	15	6 23	98	10.89	4 25	7500	29½	40.7	2.51	4.86	11.63	14.02
1496	14	6 33	97	11.04	4 31	7600	30	41.2	2.55	5.0	11.83	13.93
1488	14	6 43	96	11.19	4 36	7700	...	41.7	2.59	5.2	12.03	13.84
1480	14	6 54	95	11.34	4 42	7800	...	42.2	2.63	5.4	12.23	13.76
1472	13	7 4	94	11.48	4 48	7900	...	42.7	2.66	5.6	12.43	13.67
1464	13	7 15	93	11.63	4 54	8000	...	43.2	2.70	5.8	12.64	13.59
1456	13	7 26	92	11.77	5 0	8100	...	43.7	2.74	6.0	12.84	13.50
1448	12	7 37	91	11.92	5 6	8200	...	44.3	2.78	6.2	13.05	13.42
1440	12	7 48	90	12.07	5 12	8300	...	44.8	2.82	6.4	13.26	13.33
1432	12	8 0	89	12.22	5 18	8400	...	45.4	2.86	6.6	13.47	13.25
1424	12	8 12	88	12.36	5 24	8500	...	45.9	2.90	6.8	13.68	13.16
1417	11	8 24	87	12.51	5 30	8600	...	46.5	2.95	7.0	13.90	13.08
1409	11	8 40	86	12.65	5 36	8700	...	47.0	3.00	7.2	14.12	12.99
1402	11	8 49	85	12.80	5 42	8800	...	47.6	3.05	7.4	14.34	12.91
1394	10	9 3	84	12.94	5 48	8900	...	48.2	3.11	7.6	14.56	12.82
1387	10	9 15	83	13.09	5 54	9000	...	48.8	3.17	7.8	14.79	12.74
1379	10	9 28	82	13.24	6 0	9100	...	49.3	3.23	8.0	15.01	12.65
1372	10	9 42	81	13.38	6 7	9200	...	49.8	3.30	8.3	15.24	12.57
1364	9	9 56	80	13.53	6 13	9300	...	50.4	3.37	8.6	15.47	12.49
1357	9	10 10	79	13.67	6 20	9400	...	51.0	3.44	8.9	15.70	12.41
1349	9	10 24	78	13.81	6 26	9500	...	51.6	3.52	9.2	15.93	12.33
1342	9	10 38	77	13.96	6 33	9600	...	52.2	3.61	9.5	16.17	12.25
1335	9	10 52	77	14.11	6 39	9700	...	52.8	3.70	9.9	16.41	12.16
1328	8	11 7	76	14.26	6 46	9800	...	53.3	3.79	10.1	16.66	12.08
1321	8	11 22	75	14.40	6 52	9900	...	53.9	3.89	10.4	16.91	11.99
1314	8	11 37	74	14.55	6 59	10000	...	54.5	4.00	10.7	17.16	11.91

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X—*continued*.

Remaining velocity. (Actual.)	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for fuze, time and percussion, middle, No. 54, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.		
f.s.	yards.	° /	yards.	yards.	° /	yards.		yards.	yards.	yards.	secs.	ins.
1307	8	11 52	73	14.69	7 5	10100	...	55.0	4.10	11.0	17.41	11.82
1300	8	12 8	72	14.84	7 12	10200	...	55.6	4.22	11.3	17.66	11.74
1293	8	12 23	72	14.98	7 19	10300	...	56.2	4.34	11.6	17.91	11.66
1286	7	12 38	71	15.13	7 26	10400	...	56.8	4.46	11.9	18.16	11.58
1279	7	12 53	71	15.27	7 33	10500	...	57.3	4.58	12.2	18.41	11.50
1270	7	13 9	70	15.42	7 40	10600	...	58.0	4.70	12.7	18.67	11.42
1265	7	13 24	69	15.56	7 47	10700	...	58.6	4.83	13.1	18.93	11.34
1258	7	13 40	68	15.71	7 54	10800	...	59.2	4.97	13.5	19.19	11.27
1251	7	13 55	67	15.85	8 1	10900	...	59.8	5.12	13.9	19.45	11.19
1244	7	14 11	66	16.00	8 9	11000	...	60.3	5.27	14.3	19.72	11.12
1237	6	14 26	65	16.14	8 16	11100	...	60.8	5.42	14.7	19.99	11.05
1230	6	14 42	64	16.29	8 24	11200	...	61.5	5.58	15.1	20.26	10.98
1223	6	14 58	63	16.43	8 32	11300	...	62.2	5.76	15.5	20.54	10.91
1216	6	15 15	62	16.58	8 40	11400	...	62.8	5.92	15.9	20.82	10.84
1209	6	15 31	61	16.72	8 48	11500	...	63.4	6.10	16.3	21.10	10.77
1202	6	15 48	60	16.87	8 57	11600	...	64.0	6.27	16.7	21.39	10.70
1195	6	16 4	59	17.01	9 5	11700	...	64.6	6.45	17.1	21.68	10.63
1188	6	16 21	58	17.16	9 14	11800	...	65.2	6.64	17.5	21.98	10.56
1181	6	16 37	58	17.30	9 22	11900	...	65.8	6.83	17.9	22.28	10.49
1174	5	16 54	57	17.45	9 31	12000	...	66.5	7.03	18.3	22.58	10.42
1167	5	17 11	57	17.59	9 40	12100	...	67.1	7.23	18.7	22.88	10.35
1160	5	17 28	56	17.74	9 49	12200	...	67.7	7.42	19.1	23.18	10.28
1153	5	17 45	55	17.88	9 58	12300	...	68.3	7.62	19.5	23.48	10.21
1146	5	18 3	54	18.03	10 7	12400	...	69.0	7.83	19.9	23.78	10.15
1139	5	18 20	53	18.17	10 16	12500	...	69.6	8.05	20.3	24.08	10.08
1132	5	18 38	52	18.32	10 26	12600	...	70.2	8.26	20.7	24.39	10.02
1126	5	18 55	51	18.46	10 36	12700	...	70.8	8.50	21.1	24.69	9.95
1120	5	19 13	50	18.61	10 46	12800	...	71.5	8.74	21.5	25.00	9.89
1113	5	19 31	49	18.75	10 56	12900	...	72.0	9.00	21.9	25.31	9.82
1107	5	19 49	48	18.90	11 6	13000	...	72.6	9.25	22.3	25.62	9.76
1100	5	20 7	48	19.04	11 16	13100	...	73.3	9.50	22.7	25.94	9.69
1094	4	20 25	47	19.19	11 27	13200	...	73.8	9.75	23.1	26.26	9.63
1088	4	20 43	47	19.33	11 37	13300	...	74.5	10.00	23.5	26.58	9.56
1082	4	21 1	46	19.48	11 48	13400	...	75.1	10.28	23.9	26.91	9.50
1076	4	21 19	46	19.62	11 59	13500	...	75.7	10.55	24.3	27.24	9.43
1070	4	21 38	45	19.77	12 10	13600	...	76.4	10.82	24.7	27.57	9.37
1064	4	21 56	45	19.91	12 21	13700	...	77.1	11.10	25.1	27.90	9.30
1058	4	22 15	44	20.06	12 32	13800	...	77.7	11.40	25.5	28.24	9.24
1052	4	22 32	44	20.20	12 43	13900	...	78.4	11.70	25.9	28.58	9.17
1046	4	22 52	44	20.35	12 54	14000	...	79.0	12.00	26.3	28.92	9.11

The proportional resistance to penetration of wrought iron, compound or mild steel, and Harveyed armour, may be taken roughly as 1 : 1½ : 2.

A 9.2-inch common shell, with a velocity of about 2,000 f.s., may be expected to perforate about 6 inches of Harveyed armour, if struck direct, or about 5 inches at 30° to the normal.

Under similar circumstances, a 9.2-inch armour-piercing shell may be expected to perforate about 9 inches and 7 inches Harveyed armour, and it would probably perforate 9 inches of compound or mild steel armour if struck direct or at an angle of 30° to the normal.

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X.  
( $\frac{3}{4}$  Composite Charge.)

Based on Practice of 30.7.00 and 11.6.01.

40185  
9494

(Minutes 43,941, 49,756 III, and 51,544.)

Charge, { weight, 77 $\frac{1}{2}$  lb.  
gravimetric density,  $\frac{106.7}{0.260}$   
nature, { 74 $\frac{1}{2}$  lb. cordite, size 41, and  
3 " " " 3 $\frac{3}{4}$ .  
Projectile, { nature, cast steel, pointed, com-  
mon shell, Mark II.  
weight, 380 lb.

Muzzle velocity, 2,196 f.s.  
Nature of mounting, Barbette,  
Mark V.  
Jump, nil.

Remaining velocity. (Actual.)	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for time fuze, and percussion, middle, No. 34, Marks I, II, and III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
f.s.	yards.	° ' "	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	secs.
2177	1432	0 4	142	0.14	0 3	100	1	...	...	...	0.14
2153	714	0 8	140	0.29	0 7	200	1	...	...	...	0.29
2139	477	0 12	138	0.43	0 11	300	1	...	...	...	0.43
2120	358	0 16	136	0.58	0 15	400	1	...	...	...	0.58
2091	286	0 20	134	0.72	0 19	500	1	...	...	...	0.73
2083	229	0 25	132	0.87	0 23	600	2	21.0	0.35	0.1	0.88
2065	197	0 29	130	1.01	0 27	700	2	21.4	0.37	0.1	1.03
2047	169	0 34	128	1.16	0 31	800	2	21.9	0.40	0.1	1.18
2029	151	0 38	126	1.31	0 35	900	3	22.3	0.42	0.1	1.33
2011	133	0 43	124	1.45	0 39	1000	3	22.8	0.45	0.1	1.48
1993	122	0 47	122	1.60	0 43	1100	4	23.2	0.47	0.1	1.63
1975	110	0 52	121	1.74	0 47	1200	4	23.7	0.50	0.1	1.78
1958	100	0 57	120	1.89	0 51	1300	4	24.1	0.52	0.2	1.93
1941	92	1 2	119	2.03	0 55	1400	5	24.6	0.55	0.2	2.09
1924	87	1 6	118	2.18	0 59	1500	5	25.0	0.57	0.3	2.24
1907	81	1 11	117	2.32	1 3	1600	6	25.5	0.60	0.3	2.40
1890	75	1 16	116	2.47	1 7	1700	6	25.9	0.63	0.4	2.56
1874	71	1 21	115	2.61	1 11	1800	6	26.4	0.66	0.4	2.72
1858	66	1 26	114	2.76	1 15	1900	7	26.8	0.69	0.5	2.88
1842	63	1 31	113	2.91	1 19	2000	7	27.3	0.72	0.5	3.04
1826	59	1 36	112	3.05	1 23	2100	8	27.7	0.76	0.6	3.20
1810	56	1 41	111	3.20	1 27	2200	8	28.2	0.80	0.6	3.37
1794	54	1 46	110	3.34	1 31	2300	8	28.7	0.84	0.7	3.53
1778	51	1 52	109	3.49	1 35	2400	9	29.2	0.88	0.8	3.70
1762	49	1 57	108	3.63	1 39	2500	9	29.7	0.92	0.9	3.86
1747	46	2 3	107	3.78	1 44	2600	10	30.2	0.96	1.0	4.03
1732	44	2 9	106	3.92	1 48	2700	10	30.7	1.00	1.1	4.20
1717	42	2 15	105	4.07	1 53	2800	11	31.2	1.04	1.2	4.37
1702	40	2 21	104	4.21	1 57	2900	11	31.7	1.08	1.3	4.54
1687	39	2 27	103	4.36	2 2	3000	11	32.3	1.12	1.4	4.71
1672	37	2 33	102	4.51	2 7	3100	12	32.8	1.16	1.5	4.88
1658	36	2 39	101	4.65	2 12	3200	12	33.4	1.20	1.6	5.05
1644	34	2 45	100	4.80	2 17	3300	13	34.0	1.24	1.7	5.22
1630	33	2 52	99	4.94	2 22	3400	13	34.6	1.28	1.8	5.40
1616	32	2 59	98	5.09	2 27	3500	14	35.2	1.33	1.9	5.58

RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X—continued.

Remaining velocity. (Actual)	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Ftze scale for time fuze, and percussion, middle, No. 54, Marks I*, II, and III.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
f.s.	yards.	° '	yards.	yards.	° '	yards.		yards.	yards.	yards.	secs.
1603	31	3 6	97	5.23	2 32	3600	14½	35.8	1.38	2.0	6.76
1589	29	3 13	96	5.33	2 37	3700	15	36.4	1.43	2.1	6.94
1575	28	3 21	95	5.52	2 43	3800	15½	37.0	1.48	2.2	7.12
1562	27	3 28	94	5.67	2 48	3900	16	37.6	1.53	2.3	7.30
1549	26	3 36	93	5.81	2 54	4000	16½	38.2	1.58	2.4	7.49
1536	25	3 44	92	5.96	2 59	4100	17	38.8	1.63	2.6	7.68
1524	24	3 52	91	6.11	3 5	4200	17½	39.4	1.68	2.8	7.87
1512	24	4 0	90	6.25	3 10	4300	18	40.0	1.73	3.0	8.06
1500	23	4 9	89	6.40	3 16	4400	18½	40.6	1.78	3.2	8.26
1488	22	4 17	88	6.54	3 21	4500	19	41.3	1.83	3.4	8.46
1476	22	4 26	87	6.69	3 27	4600	19½	42.0	1.88	3.6	8.66
1464	21	4 35	86	6.83	3 33	4700	20	42.7	1.93	3.8	8.86
1453	20	4 44	85	6.98	3 39	4800	20½	43.4	1.99	4.0	9.07
1442	19	4 53	84	7.13	3 45	4900	21	44.1	2.04	4.2	9.27
1431	19	5 3	83	7.27	3 51	5000	21½	44.9	2.10	4.4	9.48
1421	18	5 13	82	7.42	3 57	5100	22	45.6	2.15	4.6	9.69
1411	18	5 23	81	7.56	4 3	5200	22½	46.4	2.21	4.8	9.90
1401	17	5 33	80	7.71	4 9	5300	23	47.1	2.26	5.0	10.11
1391	17	5 43	79	7.85	4 15	5400	23½	47.9	2.32	5.2	10.33
1381	16	5 53	78	8.00	4 21	5500	24	48.6	2.37	5.4	10.54
1371	16	6 4	77	8.14	4 27	5600	25	49.4	2.43	5.6	10.76
1361	15	6 15	76	8.29	4 33	5700	25½	50.2	2.49	5.9	10.98
1351	15	6 25	75	8.43	4 40	5800	26	51.0	2.55	6.2	11.20
1341	14	6 27	74	8.58	4 46	5900	26½	51.9	2.61	6.5	11.42
1332	14	6 48	73	8.73	4 53	6000	27	52.8	2.67	6.8	11.65
1323	13	6 59	72	8.87	5 0	6100	27½	53.7	2.73	7.1	11.88
1314	13	7 11	71	9.01	5 7	6200	28	54.6	2.80	7.4	12.11
1305	13	7 22	70	9.16	5 14	6300	29	55.5	2.86	7.8	12.34
1297	12	7 34	69	9.30	5 21	6400	29½	56.4	2.93	8.1	12.57
1289	12	7 46	68	9.45	5 28	6500	...	57.3	2.99	8.5	12.81
1281	12	7 58	67	9.60	5 35	6600	...	58.3	3.06	8.8	13.05
1273	11	8 9	66	9.74	5 42	6700	...	59.2	3.12	9.2	13.29
1265	11	8 21	65	9.89	5 50	6800	...	60.2	3.19	9.6	13.53
1257	11	8 33	64	10.03	5 57	6900	...	61.2	3.25	10.0	13.77
1250	11	8 45	63	10.18	6 5	7000	...	62.2	3.32	10.4	14.02
1242	10	8 57	63	10.32	6 13	7100	...	63.3	3.38	10.8	14.26
1235	10	9 10	62	10.46	6 21	7200	...	64.4	3.45	11.2	14.51
1227	10	9 23	62	10.60	6 29	7300	...	65.5	3.51	11.6	14.75
1220	9	9 36	61	10.75	6 37	7400	...	66.7	3.58	12.1	15.00
1213	9	9 49	61	10.89	6 45	7500	...	67.8	3.64	12.6	15.24
1206	9	10 3	60	11.04	6 53	7600	...	69.0	3.71	13.1	15.49
1199	9	10 17	60	11.19	7 1	7700	...	70.02	3.77	13.6	15.74
1193	9	10 31	59	11.34	7 9	7800	...	71.4	3.84	14.2	16.00
1187	8	10 45	59	11.48	7 17	7900	...	72.6	3.90	14.8	16.25
1181	8	11 0	58	11.63	7 26	8000	...	73.8	3.97	15.4	16.51
1175	8	11 15	58	11.77	7 34	8100	...	75.0	4.04	16.0	16.76
1170	8	11 30	57	11.92	7 43	8200	...	76.3	4.11	16.6	17.02
1165	8	11 45	57	12.07	7 51	8300	...	77.6	4.18	17.2	17.28
1160	7	12 1	56	12.22	8 0	8400	...	78.9	4.25	17.8	17.54
1155	7	12 17	56	12.36	8 9	8500	...	80.2	4.32	18.4	17.80
1150	7	12 33	55	12.51	8 18	8600	...	81.6	4.39	19.0	18.06
1145	7	12 49	55	12.65	8 27	8700	...	83.0	4.46	19.6	18.32
1141	7	13 6	54	12.80	8 37	8800	...	84.4	4.53	20.3	18.58
1137	7	13 22	54	12.94	8 46	8900	...	85.8	4.60	21.0	18.84
1133	6	13 39	53	13.09	8 56	9000	...	87.2	4.68	21.7	19.10
1129	6	13 56	53	13.24	9 5	9100	...	88.6	4.75	22.4	19.36
1126	6	14 13	52	13.39	9 15	9200	...	90.0	4.83	23.1	19.62
1122	6	14 30	52	13.53	9 25	9300	...	91.4	4.91	23.8	19.88
1119	6	14 48	51	13.67	9 35	9400	...	92.8	4.99	24.6	20.14
1116	6	15 6	51	13.81	9 45	9500	...	94.2	5.07	25.4	20.40



RANGE TABLE for 9.2-inch B.L. Guns, Marks IX and X—*continued*.

Remaining velocity. (Actual.)	To strike an object 10 feet high, range must be known within	Angle of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	Fuze scale for time fuze, and percussion, middle, No. 54, Marks 1 <sup>st</sup> , 11, and 111.	50 per cent. of rounds should fall in			Time of flight.
			Range.	Vertically or laterally.				Length.	Breadth.	Height.	
f. s.	yards.	° ' "	yards.	yards.	° ' "	yards.		yards.	yards.	yards.	secs.
1113	6	15 24	50	13.96	9 55	9600	...	95.7	5.15	26.3	19.74
1110	6	15 42	50	14.11	10 5	9700	...	97.2	5.23	27.1	20.03
1107	5	16 0	49	14.26	10 16	9800	...	98.3	5.31	28.0	20.32
1104	5	16 18	49	14.40	10 25	9900	...	100.3	5.39	28.9	20.61
1101	5	16 37	48	14.55	10 35	10000	...	101.9	5.47	29.9	20.91
1097	5	16 54	48	14.69	10 45	10100	...	103.5	5.55	30.9	21.21
1095	5	17 14	47	14.84	10 56	10200	...	105.1	5.64	32.0	21.51
1092	5	17 33	47	14.98	11 6	10300	...	106.7	5.73	33.0	21.81
1090	5	17 52	46	15.13	11 17	10400	...	108.3	5.82	34.1	22.12
1087	5	18 11	46	15.27	11 28	10500	...	109.9	5.91	35.1	22.43
1085	5	18 30	45	15.42	11 39	10600	...	111.5	6.01	36.2	22.74
1082	4	18 49	45	15.56	11 50	10700	...	113.1	6.11	37.2	23.05
1080	4	19 9	44	15.71	12 1	10800	...	114.7	6.21	38.3	23.36
1078	4	19 28	44	15.85	12 12	10900	...	116.3	6.31	39.4	23.67
1076	4	19 48	43	16.00	12 24	11000	...	117.9	6.41	40.5	23.99
1074	4	20 8	43	16.14	12 35	11100	...	119.5	6.51	41.6	24.31
1072	4	20 28	42	16.29	12 47	11200	...	121.1	6.61	42.7	24.63
1070	4	20 48	42	16.43	12 58	11300	...	122.7	6.71	43.8	24.95
1068	4	21 9	41	16.58	13 10	11400	...	124.3	6.81	45.0	25.28
1066	4	21 29	41	16.72	13 22	11500	...	125.9	6.91	46.1	25.60
1064	4	21 50	40	16.87	13 34	11600	...	127.5	7.01	47.3	25.98
1062	4	22 10	40	17.01	13 46	11700	...	129.1	7.11	48.5	26.26
1060	4	22 31	39	17.16	13 58	11800	...	130.7	7.21	49.7	26.59
1058	4	22 51	39	17.30	14 10	11900	...	132.3	7.31	50.9	26.92
1056	3	23 12	39	17.45	14 22	12000	...	133.9	7.41	52.1	27.26

# RANGE TABLE for 9.2-inch B.L. Gun, Mark X (three-quarter charge).

Based on Practice of 23.8 and 14.9.04, previous to which the gun had fired  
17 proof, 52 full, and 34 reduced charges.

40
W.O.
274

*Minutes 57,983 and 59,017II.*

Charge,	weight, 90 lb.	Muzzle velocity, 2,225 f.s., in a nearly new gun, at 80° Fah.
	gravimetric density, $\frac{90.3}{0.307}$	
Projectile,	nature, cordite M.D., size 37.	Nature of mounting, barbette, Mark V.
	nature, cast steel, pointed, common shell, Mark VI. weight, 380 lb.	
		Jump, nil.

NOTE.—This Range Table is also suitable for the 9.2-inch B.L. gun, Mark IX, on  
barbette mountings, Marks III and IV, with the following modifications:—

On Mark III mounting the jump is -7 minutes, and the elevations given  
in the table should be increased by that amount.

On the Mark IV mounting the jump is + 3 minutes, and the elevations  
should be reduced to that extent throughout.

Remaining velocity (actual).	5 minutes' elevation or deflection alters point of impact.		To strike an object 10 feet high, range must be known within	Angle of descent.	ELEVATION.	RANGE.	50 per cent. of rounds should fall in			Time of flight.
	Range.	Vertically or laterally.					Length.	Breadth.	Height.	
f.s.	yards.	yards.	yards.	° /	° /	yards.	yards.	yards.	yards.	secs.
2207	149	0.14	1432	0 4	0 3	100	...	...	...	0.13
2189	147	0.29	716	0 8	0 7	200	...	...	...	0.27
2172	146	0.43	477	0 12	0 10	300	...	...	...	0.41
2154	144	0.58	358	0 16	0 14	400	...	...	...	0.55
2136	142	0.72	286	0 20	0 17	500	...	...	...	0.69
2119	141	0.87	239	0 24	0 21	600	21.0	0.35	0.1	0.83
2101	139	1.01	205	0 28	0 24	700	21.4	0.37	0.1	0.97
2084	137	1.16	179	0 32	0 28	800	21.9	0.40	0.1	1.11
2066	136	1.31	159	0 36	0 31	900	22.3	0.42	0.1	1.26
2049	134	1.45	143	0 40	0 35	1000	22.8	0.45	0.1	1.40
2031	132	1.60	130	0 44	0 39	1100	23.2	0.47	0.1	1.55
2014	131	1.74	119	0 48	0 43	1200	23.7	0.50	0.1	1.70
1997	129	1.89	110	0 52	0 47	1300	24.1	0.52	0.2	1.85
1980	128	2.03	102	0 56	0 51	1400	24.6	0.55	0.2	2.00
1963	126	2.18	95	1 0	0 55	1500	25.0	0.57	0.3	2.15
1946	125	2.32	88	1 5	0 59	1600	25.5	0.60	0.3	2.30
1929	123	2.47	83	1 9	1 3	1700	25.9	0.63	0.4	2.46
1912	122	2.61	77	1 14	1 7	1800	26.4	0.66	0.4	2.61
1895	120	2.76	73	1 19	1 11	1900	26.8	0.69	0.5	2.77
1878	119	2.91	68	1 24	1 15	2000	27.3	0.72	0.5	2.93
1861	117	3.05	64	1 29	1 19	2100	27.7	0.76	0.6	3.09
1845	116	3.20	61	1 34	1 24	2200	28.2	0.80	0.6	3.25
1829	115	3.34	57	1 40	1 28	2300	28.7	0.84	0.7	3.41
1813	113	3.49	55	1 45	1 33	2400	29.2	0.88	0.8	3.57
1798	112	3.63	52	1 51	1 37	2500	29.7	0.92	0.9	3.74
1783	110	3.78	49	1 57	1 42	2600	30.2	0.96	1.0	3.91
1768	109	3.92	46	2 4	1 46	2700	30.7	1.00	1.1	4.08
1753	108	4.07	44	2 10	1 51	2800	31.2	1.04	1.2	4.25
1738	106	4.21	42	2 17	1 55	2900	31.7	1.08	1.3	4.42
1723	105	4.36	40	2 23	2 0	3000	32.3	1.12	1.4	4.60

RANGE TABLE for 9.2-inch B.L. Gun, Mark X—continued.

Remaining velocity (actual).	5 minutes' elevation or deflection alters point of impact.		To strike an object 10 feet high, range must be known within	Angle of descent.	ELEVATION.	Range.	50 per cent. of rounds should fall in			Time of flight.
	Range.	Vertically or laterally.					Length.	Breadth.	Height.	
f.s.	yards.	yards.	yards.	° /	° /	yards.	yards.	yards.	yards.	secs.
1708	104	4.51	38	2 30	2 5	3100	32.8	1.16	1.5	4.78
1693	103	4.65	37	2 36	2 10	3200	33.4	1.20	1.6	4.96
1679	101	4.80	35	2 43	2 15	3300	34.0	1.24	1.7	5.14
1664	100	4.94	34	2 50	2 20	3400	34.6	1.28	1.8	5.32
1650	99	5.09	32	2 57	2 25	3500	35.2	1.33	1.9	5.50
1635	98	5.23	31	3 4	2 30	3600	35.8	1.38	2.0	5.68
1621	96	5.38	30	3 12	2 35	3700	36.4	1.43	2.1	5.86
1606	95	5.52	29	3 19	2 40	3800	37.0	1.48	2.2	6.05
1592	94	5.67	28	3 27	2 45	3900	37.6	1.53	2.3	6.24
1578	93	5.81	27	3 35	2 50	4000	38.2	1.58	2.4	6.43
1564	92	5.96	26	3 43	2 55	4100	38.8	1.63	2.6	6.62
1551	91	6.11	25	3 52	3 1	4200	39.4	1.68	2.8	6.82
1538	90	6.25	24	4 0	3 7	4300	40.0	1.73	3.0	7.02
1525	89	6.40	23	4 9	3 13	4400	40.6	1.78	3.2	7.22
1512	87	6.54	22	4 18	3 19	4500	41.3	1.83	3.4	7.42
1499	86	6.69	21	4 27	3 25	4600	42.0	1.89	3.6	7.62
1486	85	6.83	21	4 36	3 31	4700	42.7	1.93	3.8	7.82
1474	84	6.98	20	4 46	3 37	4800	43.4	1.99	4.0	8.03
1461	83	7.13	19	4 56	3 43	4900	44.1	2.04	4.2	8.24
1449	82	7.27	19	5 6	3 49	5000	44.9	2.10	4.4	8.45
1437	81	7.42	18	5 16	3 55	5100	45.6	2.15	4.6	8.66
1425	80	7.56	18	5 26	4 1	5200	46.4	2.21	4.8	8.87
1413	79	7.71	17	5 36	4 7	5300	47.1	2.26	5.0	9.08
1401	78	7.85	17	5 46	4 13	5400	47.9	2.32	5.2	9.29
1390	77	8.00	16	5 57	4 19	5500	48.6	2.37	5.4	9.51
1379	76	8.14	16	6 8	4 26	5600	49.4	2.43	5.6	9.73
1368	75	8.29	15	6 19	4 32	5700	50.2	2.49	5.9	9.95
1357	75	8.43	15	6 31	4 39	5800	51.0	2.55	6.2	10.17
1346	74	8.58	14	6 42	4 46	5900	51.9	2.61	6.5	10.39
1335	73	8.73	14	6 54	4 53	6000	52.8	2.67	6.8	10.62
1324	72	8.87	13	7 5	5 0	6100	53.7	2.73	7.1	10.85
1313	71	9.01	13	7 17	5 7	6200	54.6	2.80	7.4	11.08
1303	70	9.16	13	7 29	5 14	6300	55.5	2.86	7.8	11.31
1293	69	9.30	12	7 41	5 21	6400	56.4	2.93	8.1	11.54
1283	68	9.45	12	7 53	5 28	6500	57.3	2.99	8.5	11.77
1274	68	9.60	12	8 6	5 35	6600	58.3	3.06	8.8	12.00
1265	67	9.74	11	8 19	5 42	6700	59.2	3.12	9.2	12.24
1256	66	9.89	11	8 33	5 50	6800	60.2	3.19	9.6	12.48
1247	65	10.03	11	8 46	5 57	6900	61.2	3.25	10.0	12.72
1239	65	10.18	11	9 0	6 5	7000	62.2	3.32	10.4	12.96
1231	64	10.32	10	9 14	6 13	7100	63.3	3.38	10.8	13.21
1223	63	10.46	10	9 28	6 21	7200	64.4	3.45	11.2	13.46
1215	62	10.60	10	9 42	6 29	7300	65.5	3.51	11.6	13.71
1207	62	10.75	10	9 57	6 37	7400	66.7	3.58	12.1	13.97
1200	61	10.89	9	10 12	6 45	7500	67.8	3.64	12.6	14.23
1193	60	11.04	9	10 27	6 53	7600	69.0	3.71	13.1	14.49
1187	59	11.19	9	10 42	7 1	7700	70.2	3.77	13.6	14.75
1181	59	11.34	9	10 57	7 9	7800	71.4	3.84	14.2	15.01
1175	58	11.48	8	11 13	7 18	7900	72.6	3.90	14.8	15.27
1169	57	11.63	8	11 29	7 26	8000	73.8	3.97	15.4	15.53
1163	57	11.77	8	11 45	7 35	8100	75.0	4.04	16.0	15.80
1157	56	11.92	8	12 1	7 44	8200	76.3	4.11	16.6	16.07
1151	55	12.07	8	12 18	7 53	8300	77.6	4.18	17.2	16.34
1145	55	12.22	7	12 34	8 2	8400	78.9	4.25	17.8	16.61
1140	54	12.36	7	12 51	8 11	8500	80.2	4.32	18.4	16.88
1134	54	12.51	7	13 8	8 20	8600	81.6	4.39	19.0	17.15
1129	53	12.65	7	13 25	8 30	8700	83.0	4.46	19.6	17.42
1124	52	12.80	7	13 42	8 39	8800	84.4	4.53	20.3	17.69
1119	52	12.94	7	14 0	8 49	8900	85.8	4.60	21.0	17.96
1114	51	13.09	7	14 18	8 59	9000	87.2	4.68	21.7	18.24

RANGE TABLE for 9.2-inch B.L. Gun, Mark X—continued.

Remaining velocity (actual).	5 minutes' elevation or deflection alters point of impact.		To strike an object 10 feet high, range must be known within	Angle of descent.	ELEVATION.	RANGE.	50 per cent. of rounds should fall in			Time of flight.
	Range.	Vertically or laterally.					Length.	Breadth.	Height.	
f.s.	yards.	yards.	yards.	° /	° /	yards.	yards.	yards.	yards.	secs.
1109	51	13.24	6	14 36	9 9	9100	88.6	4.75	22.4	19.52
1101	50	13.38	6	14 54	9 19	9210	90.0	4.83	23.1	18.80
1099	50	13.53	6	15 13	9 29	9300	91.4	4.91	23.8	19.08
1095	49	13.67	6	15 32	9 33	9400	92.8	4.99	24.6	19.37
1091	48	13.81	6	15 51	9 49	9500	94.2	5.07	25.4	19.66
1087	48	13.96	6	16 10	9 59	9600	95.7	5.15	26.3	19.95
1083	48	14.11	6	16 29	10 9	9700	97.2	5.23	27.1	20.24
1079	47	14.26	6	16 49	10 20	9800	98.8	5.31	28.0	20.53
1076	46	14.40	5	17 8	10 30	9900	100.3	5.39	28.9	20.82
1072	46	14.55	5	17 28	10 41	10000	101.9	5.47	29.9	21.12
1069	46	14.69	5	17 48	10 52	10100	103.5	5.55	30.9	21.42
1066	45	14.84	5	18 8	11 3	10200	105.1	5.64	32.0	21.72
1063	45	14.98	5	19 28	11 14	10300	106.7	5.73	33.0	22.03
1060	44	15.13	5	18 48	11 25	10400	108.3	5.82	34.1	22.34
1057	44	15.27	5	19 8	11 36	10500	109.9	5.91	35.1	22.65
1055	44	15.42	5	19 28	11 48	10600	111.5	6.01	36.2	22.97
1052	43	15.56	5	19 49	11 59	10700	113.1	6.11	37.2	23.29
1050	43	15.71	5	20 9	12 11	10800	114.7	6.21	38.3	23.61
1048	42	15.85	4	20 30	12 23	10900	116.3	6.31	39.4	23.93
1046	42	16.00	4	20 50	12 35	11000	117.9	6.41	40.5	24.25
1044	42	16.14	4	21 11	12 47	11100	119.5	6.51	41.6	24.57
1042	41	16.29	4	21 31	12 59	11200	121.1	6.61	42.7	24.89
1040	41	16.43	4	21 52	13 11	11300	122.7	6.71	43.8	25.21
1038	41	16.58	4	22 13	13 23	11400	124.3	6.81	45.0	25.53
1036	40	16.72	4	22 34	13 35	11500	125.9	6.91	46.1	25.85
1034	40	16.87	4	22 55	13 47	11600	127.5	7.01	47.3	26.17
1032	40	17.01	4	23 16	13 59	11700	129.1	7.11	48.5	26.49
1030	39	17.16	4	23 37	14 12	11800	130.7	7.21	49.7	26.81
1029	39	17.30	4	23 58	14 24	11900	132.3	7.31	50.9	27.13
1027	39	17.45	4	24 19	14 37	12000	133.9	7.41	52.1	27.46
1026	38	17.59	4	24 40	14 49	12100	...	...	...	27.78
1025	38	17.74	4	25 1	15 2	12200	...	...	...	28.11

## RANGE TABLE for 1-inch Aiming Tube.

Based on Practice of 25.6.00.

$$\frac{71}{1} = 71$$

Minute, 49629 (a) and (b).

AMMUNITION, ELECTRIC, AIMING RIFLE, MARK IV, M. OR K.N., OR  
PERCUSSION, MARK I.

Muzzle velocity, 1100 f.s.

Slope of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.	RANGE.	50 per cent. of rounds should fall in .		
	Range.	Vertically or laterally.			Length.	Breadth.	Height.
1 in.	yards.	yards.	degs. mins.	yards.	yards.	yards.	yards.
343	31	0.14	0 16	100			
149	31	0.29	0 32	200			
90	30	0.43	0 48	300			
61	30	0.58	1 4	400			
45	29	0.72	1 21	500			
35	29	0.87	1 39	600	10.0	0.36	0.30
28	28	1.01	1 55	700	10.3	0.38	0.40
23	27	1.16	2 12	800	10.7	0.40	0.52
19	27	1.31	2 30	900	11.2	0.43	0.64
16	26	1.45	2 49	1000	11.8	0.46	0.78
14	25	1.60	3 9	1100	12.5	0.50	0.94
12	25	1.74	3 30	1200	13.2	0.55	1.12
10	24	1.89	3 52	1300	13.9	0.61	1.32
9	23	2.03	4 15	1400	14.7	0.69	1.56
8	22	2.18	4 38	1500	15.6	0.77	1.84
7	21	2.32	5 1	1600	16.6	0.87	2.16
7	20	2.47	5 25	1700	17.7	0.98	2.53
6	19	2.61	5 50	1800	18.9	1.10	2.96
6	18	2.76	6 16	1900	20.1	1.23	3.44
5	18	2.91	6 43	2000	21.4	1.37	3.97
5	18	3.05	7 10	2100	22.7	1.53	4.55
5	17	3.20	7 38	2200	24.0	1.70	5.20
4	17	3.34	8 6	2300	25.3	1.87	5.90
4	17	3.49	8 34	2400	26.6	2.05	6.64
4	17	3.63	9 2	2500	28.0	2.25	7.40

NOTE.—When firing over water at 1,000 yards range, the bullets ricocheted about 1,200 yards more, coming to rest at a range of about 2,200 yards.

## DRILL FOR 9·2-INCH: B.L. GUN, MARK IX, ON BARBETTE, MARK III, MOUNTING.

The gun detachment consists of a Gun Captain, a Gun Layer, and nine other gun numbers, and an additional layer from the 50 % spare. It falls in and is told off in the usual manner.

For the duties of Gun Captain and Gun Layer, see "Garrison Artillery Training."

### AMMUNITION SUPPLY.

Cartridges are supplied from recesses (or depôts if required) by hand to the gun. Supply may also be made to the level of the emplacement by lift.

Projectiles are supplied from recesses in the emplacement, and from depôts which should be arranged round the gun platform under cover of the parapet.

The lift from the shell and cartridge store, by means of which these recesses and depôts are supplied, may be used for direct supply in action if necessary.

The normal supply of ammunition will be from the recesses or depôts; in this case 6 and 8 supply cartridges, and 7, 9, and 10 supply projectiles. This supply must be made intelligently, as the gun is traversed, from the most convenient recess or depôt.

When supply is from lifts, lids of cylinders will be loosened at the foot of the lift.

Empties will be stacked by 6 and 8 without obstructing the working numbers at the gun.

As the recesses and depôts only hold a limited number of rounds, it will be advisable not to reduce the total for each gun below six, but when this point has been reached to change to lift supply.

In addition to the above detail, when guns are served by lifts direct, nine additional numbers will be required to supply and work the lifts.

If only one lift is provided it is generally desirable to detail some of the numbers to carry cartridges in cylinders to cartridge recesses or depôts direct, the lift being reserved for shell only.

### TO PREPARE FOR ACTION.

See "Garrison Artillery Training."

The stores are brought up as follows from the group store:—

Gun Captain.—A piece of chalk.

Gun Layers.—Sights, pistol grip, screw-driver and convergence table.

2.—Electric lock, electric tubes, tube box, pocket gun-layers, vent bit, rimer, extractor lever, McMahon spanner, nut vent wrench, wrenches, breech and firing mechanism, oil can, Russian tallow, and waste. For drill, a drill tube.

3.—Percussion lock, percussion tubes, tube box, and lanyard, loading tray if required. For drill, a drill tube.

4.—Brush-rammer-and-sponge, bucket, filled with water, sponge-cloth and brush.

5.—Winch handle and box of spare parts.

6 and 8.—Keys of cartridge and shell recesses. For drill, drill cartridges in zinc cylinders, and cartridge extractor.

7, 9, and 10.—Projectile barrows and brush; two keys, fuze, universal; two keys, base fuze, and plug (when required); grease box; driver, grummet; mallet, tinman's. For drill, drill shell and shell extractor.

The following group stores will be brought up, and such others as are considered necessary locally:—

Hammers, claw	...	...	1 per group.
Clinometers	...	...	1 per work.
Instruments testing primary batteries	...	...	1 per work.
Drivers, screw	...	...	2 per work.
Whistles	...	...	1 per group.
Brooms	...	...	1 per group.

When the stores are brought up the Gun Captain gives "A 1, Prepare for Action," and satisfies himself that the buffers are properly connected up, not leaking at the glands, and contain the correct amount of oil, and that the capsquares are properly secured. When the breech is opened, he looks to see that the bore is clear. He sees that the ammunition is properly prepared. He superintends the firing of an electric and a percussion tube to test firing arrangements.

The Autosight Layer, assisted where necessary by the Rocking-bar Layer, fixes the sights in the gun, taking care that the foresights fit correctly, and that the deflection leaves of the hind-sights work easily. He sees that the rocking bar and automatic sights fit and work properly, that the brackets and carriers are firmly attached to the mounting, and tests the automatic sight.

He makes the necessary connections, and tests the firing circuits by firing a tube after the breech is closed when ordered to do so by the Gun Captain.

3 removes breech and muzzle covers, sees that the control gear is oiled and in good order, and inserts the percussion lock if used. He attaches the tube box to the mounting, placing some tubes in the box and the remainder in a convenient position for use, and places the lanyard under his belt.

He opens the breech by turning the lever with his left hand and swinging it round.

When the Gun Captain has looked through the bore the breech will be closed in the reverse manner.

2 attaches the tube box and layers pocket to the mounting, placing some tubes in the box and the remainder in a convenient position for use. He places the remainder of his stores in a convenient position for use. He inserts the electric lock, if used, and makes the necessary connections. When the breech is open he passes the vent bit down the vent, examines the breech-screw and threads of the breech, sees that they are clean and free from burrs, lubricates the threads with a slight film of oil and smears the obturating pad with Russian tallow.



As soon as the breech is closed he inserts an electric tube, lowers the actuating lever, and gives "*A 1, Ready.*" He then sees that the traversing gear is oiled and in good working order.

In case of percussion firing, **3** inserts a percussion tube, lowers the actuating lever, hooks the lanyard and fires when ordered to do so by the Gun Captain.

**4** sees that the elevating gear is oiled and in good working order, and with **5** he elevates the gun until the breech rests on the wood block. He places the brush-rammer-and-sponge, the bucket filled with water, and brush, in rear of the breech.

**5, 6, and 8** go to the cartridge recess, depôt, or lift, loosen or remove bands from covers of cylinders if not already done. For drill they place drill cartridges and extractor in convenient positions for use.

**7, 9, and 10** go to the shell recess, depôt, or lift, and prepare shell for loading, *i.e.*, clean and fuze them if not already done. For drill they place the drill shell and extractor in convenient positions for use. **7** hands a fuze key to **3**.

Each number will report to the Gun Captain regarding any damage or deficiency.

After each number has completed his work he takes post as follows:—

Gun Captain, in the most convenient position.

Gun Layers, on the sighting platforms.

**2**, on the right of the gun facing the breech.

**3**, on the left of the gun facing the breech.

**4 and 5** at the elevating wheel.

**6, 7, 8, 9, and 10** as above detailed.

#### TO LOAD.

Gun Group Commander.

Gun Captain.

"*A Group ..... Load.*"

"*A 1 ..... Load.*"

**4 and 5** elevate the gun if necessary into the loading position.

**3** opens the breech, assisted by **2** when required, and inserts the loading tray when used.

**2** extracts the tube, rimes out the vent, and, if necessary, uses the vent bit.

**7, 9, and 10** bring up the projectile on the barrow and up end it on to the loading tray of the carrier, they then slide the barrow clear.

**10** seizes the handle of the carrier and raises the projectile in line with the bore and when high enough places the pawl into the recess in the arc.

When the shell is on the loading tray **3** will remove the safety pin and uncap the fuze, **7** supplies himself with the rammer and stands ready to ram home.

The shell will then be rammed home in one motion by **2, 6, and 8** on the right side, **3, 7, and 9** on the left.

As soon as the shell is home, **3** will release the small cam on the carrier and allow the tray to slide down. The number at the handle then lowers the carrier.

**7 and 9** withdraw the rammer with a corkscrew motion, lay it down, **7 and 9** remove the barrow and bring up another projectile, which is placed on the loading tray and raised to the half-way notch.

NOTE.—The sponge head must be thoroughly saturated with water after each round.

The shell numbers will change rounds when required at the discretion of the Gun Captain.

6 and 8 bring up the cartridge cylinders with lids unscrewed to the last thread and place them in a convenient position, taking care that they are clear of the carrier in lowering. 6 loads the first cartridge and 8 the second, having first removed the mill board disc from each cartridge.

3 removes loading tray when used, and closes the breech. Before closing the breech, care should be taken to remove any pieces of residue which would be likely to interfere with the closing of the breech or damage the obturating pad.

2 inserts an electric tube in the vent, or 3 a percussion tube, if firing by percussion, as before detailed.

The tube is never to be inserted before the breech is properly closed under any pretext whatever.

At percussion firing 3 then hooks the lanyard and stands ready to fire.

When all are clear of recoil 2 gives the word "*A 1, Ready.*" At percussion firing 2 will not give the word "*Ready*" until 3 has hooked the lanyard and is clear of recoil.

At the word "*Ready*" 4 and 5 depress the gun until "*Halt.*" is given by the Gun Captain or Gun Layer, according to the case employed.

6 and 8 remove empty cylinders and place another charge in a convenient position for loading, as before detailed.

7, 9, and 10 prepare another projectile for loading, as before detailed. 2 and 3 man the traversing handles if required.

#### TO LAY AND FIRE.

See "*Garrison Artillery Training.*"

The normal method of firing is by electricity.

The normal means of laying is by rocking-bar sight at long ranges, and by automatic sight when the target is within effective autosight range.

Gun sights will not be used unless the other sights are out of action or not fitted. The tangent sight may have to be removed before firing.

2 and 3 traverse, and 4 and 5 elevate, if required to assist.

*Case I (Tangent Elevation).*—Rocking-bar Layer lays for line and traverses; he also lays for elevation, directing the Autosight Layer to elevate or depress, as required, and fires.

Autosight Layer elevates or depresses, as ordered by the Rocking-bar Layer.

*Autosights.*—Rocking-bar Layer lays for line and traverses, and, if ordered to do so, observes and acquaints Autosight Layer with his observations.

Autosight Layer lays for elevation, elevates and fires, and, if ordered to do so, corrects by means of the error of day drum.

*Case II.*—Autosight Layer lays for line, traverses and fires, by order of the Gun Captain, who gives the order at "*on.*"

The Rocking-bar Layer reads dial (when dial is on the mounting), puts on elevation, and gives "*on*" when the gun is correctly layed.

*Case III.*—Autosight Layer reads training dial (when on the mounting), and traverses.

Rocking-bar Layer reads range dial, and elevates.

3 fires by percussion, by order of the Gun Captain, who gives the order at "*on*" from both layers.

## AFTER FIRING.

As soon as the gun is fired the Gun Captain removes the firing plug if used; 4 and 5 bring the gun into the loading position without further word of command. At percussion firing, 3 unhooks the lanyard; 3, assisted by 2 if necessary, opens the breech; 4 lays the sponge cloth over the mushroom head, he will not wring it out but place it on as wet as possible; 2 extracts the old tube and attends to the vent. The gun will be at once reloaded.

## TO UNLOAD AT DRILL.

The gun is unloaded by the numbers who loaded, 6 supplying the cartridge extractor, 7 the shell extractor. 3 sees that the loading tray is in the proper position to protect the threads of the breech.

## FOR ACTION, UNDER COVER, MISSFIRE, CEASE FIRING, REPLACEMENT OF CASUALTIES.

See "Garrison Artillery Training."

The positions under cover are as follows:—

- 2, 4, Rocking-bar Layer and Gun Captain on the right of the gun.
- 3, 5, and Autosight Layer on the left of the gun.
- 6 and 8 at the cartridge recess or depôt.
- 7, 9, and 10 at the shell recess or depôt.

The procedure at "Missfire" being called will be as follows:—

*Electric Firing.*—After a pause of three minutes 4 and 5 elevate the gun sufficiently for the lock to be reached from the gun floor, 2 inserts a new tube. Should a missfire again result a change will be made to percussion firing, after a further pause of three minutes, as follows:—

4 and 5 again elevate, 2 removes the electric lock, 3 inserts percussion lock and tube, hooks lanyard and stands ready to fire.

NOTE.—When changing from percussion to electric firing, a similar procedure is followed.

## TO CEASE FIRING AND REPLACE STORES.

The gun is left depressed by 4 and 5, and the stores are replaced by the numbers who brought them up.

The detachment then falls in at "Detachment Rear."

## DRILL FOR 9.2-INCH B.L., MARK IX, ON BARBETTE, MARK IV, MOUNTING.

## GUN DETACHMENT.

The gun detachment consists of a Gun Captain, Gun Layer, and nine other gun numbers, and an additional layer from the 50% spare. It falls in and is told off as usual.

For the duties of Gun Captain and Gun Layer see "Garrison Artillery Training."

## AMMUNITION DETAIL.

In addition to the gun detachment, the following are required :—

Two numbers inside the magazine.

Three numbers supplying lifts with shell.

Four numbers loading and working the lifts (two at each lift.)

## TO PREPARE FOR ACTION.

See "Garrison Artillery Training."

The stores are brought up as follows from the group store :—

Gun Captain.—A piece of chalk, pressure gauge and necessary spanners.

Gun Layers.—Sights, pistol grip, shoulder piece, and screw-driver.

2.—Electric lock, electric tubes, tube box, pocket gun-layers, vent-bit, rimer, extractor lever, McMahon spanner, nut vent wrench, wrenches, breech and firing mechanism, oil can, Russian tallow, and waste. For drill, a drill-tube.

3.—Percussion lock, percussion tubes, tube box and lanyard. For drill, a drill-tube.

4.—Brush-rammer-and-sponge, bucket filled with water, brush.

5.—Box of spare parts.

6 and 8.—For drill, drill cartridges in zinc cylinders, and cartridge extractor.

7, 9, and 10.—Selvagee; two keys, fuze, universal; grease box; levers for working ammunition lifts. For drill, drill shell, and shell extractor, and 7 ft. handspike.

The ammunition number who supply lifts with shell will provide themselves with :—

Brush; two keys, base fuze and plug; ten bolts, eye, lifting; driver, grammet; mallet, tinman's.

The following group stores will be brought up, and such others as are considered necessary locally :—

Hammers, claw ... 1 per group.

Clinometers ... 1 per work.

Instruments testing primary

batteries ... 1 per work.

Drivers, screw ... 2 per work.

Whistles ... 1 per group.

Brooms ... 1 per group.

Reservoirs, compressed air ... 1 per mounting (not required for drill).

When the stores are brought up, the Gun Captain gives "A 1, *Prepare for Action*," and satisfies himself that the buffer is properly connected up, not leaking at the glands, and contains the correct amount of oil and air pressure, and that the capsquares are properly secured. When the breech is opened, he looks to see that the bore is clear. Before firing he sees that the four screws, clamping cradle bridge are removed, and placed in the rest holes provided for the purpose. (N.B.—Before this is done, it is of the utmost importance that the pressure is correct.) He sees that the ammunition is properly prepared. He superintends the firing of an electric and a percussion tube to test firing arrangements.

The Autosight Layer, assisted where necessary by the Rocking-bar Layer, fixes the sights in the gun, taking care that the

foresights fit correctly and that the deflection leaves of the hind-sights work easily. He sees that the rocking bar and automatic sights fit and work properly, that the brackets and carriers are firmly attached to the mounting, and tests the automatic sight.

He makes the necessary connections, and tests the firing circuits by firing a tube after the breech is closed when ordered to do so by the Gun Captain. He sees that the pointer for traversing arc and safety bolt are let down.

3 removes breech and muzzle covers, sees that the control gear is oiled and in good order, and inserts the percussion lock if used. He attaches the tube box to the mounting, placing some tubes in the box, and the remainder in a convenient position for use, and places the lanyard under his belt.

He opens the breech by turning the lever with his left hand and swinging it round.

When the Gun Captain has looked through the bore the breech will be closed in the reverse manner.

2 attaches the tube box and layers pocket to the mounting, placing some tubes in the box, and the remainder in a convenient position for use. He places the remainder of his stores in a convenient position for use. He inserts the electric lock if used, and makes the necessary connections. When the breech is open he passes the vent bit down the vent, examines the breech-screw and threads of the breech, sees that they are clean and free from burrs, lubricates the threads with a slight film of oil and smears the obturating pad with Russian tallow.

As soon as the breech is closed he inserts an electric tube, lowers the actuating lever, and gives "A 1, Ready." He then sees that the traversing gear is oiled and in good working order.

In case of percussion firing, 3 inserts a percussion tube, lowers the actuating lever, hooks the lanyard and fires when ordered to do so by the Gun Captain.

4 sees that the elevating gear is oiled and in good working order and, with 5, brings the gun to the loading position. He places the brush-rammer-and-sponge, the bucket filled with water, and brush, in rear of the breech on the loading stage.

5 attends to loading tackle when used.

6 and 8 go to the issue hatch of the cartridge magazine, loosen or remove bands from covers of cylinders if not already done. For drill they place drill cartridges and extractor in convenient positions for use.

7 goes to the right-hand ammunition lift on the gun floor, 9 and 10 go to the left-hand ammunition lift on the gun floor. For drill they place the drill shell and extractor in convenient positions for use. 7 hands a fuze key to 3.

Each number will report to the Gun Captain regarding any damage or deficiency.

After each number has completed his work he takes post as follows:—

Gun Captain, in most convenient position.

Gun Layers, on the sighting platforms.

2, on the right of the gun facing the breech.

3, on the left of the gun facing the breech.

4 and 5 at the elevating wheel.

6 and 8 as above detailed.

7 and 9 at the head of the right and left ammunition lifts respectively.

10 at the traversing wheel or on the left of 9 as ordered.

## TO LOAD.

Gun Group Commander.

Gun Captain.

"A Group ..... Load."

"A 1..... Load."

4 and 5 elevate the gun if necessary into the loading position.

3 opens the breech assisted by 2 when required, and inserts the loading tray when used.

2 extracts the tube, rimes out the vent, and if necessary uses the vent bit.

If the necessary ammunition is not on the upper shelter floor, 7 or 9 calls up the foot of the lift by one whistle. On being answered, he repeats the nature of ammunition required. When the trolley has been raised to the upper shelter floor, the N.C.O. in charge of the ammunition party at the foot of the lift sounds two blasts on the whistle of the speaking tube. 7 or 9, on hearing this signal, raises the trolley to the gun floor by throwing his lever over to "Raise," letting it return automatically.

N.B.—The shell would have been fuzeed in the shell-store before placing on the trolley.

7 or 9 then releases with his foot the catch securing the trolley to the lift, and pushes it round in rear of the breech.

10, if necessary, traverses the gun to a convenient position for loading; when not on the traversing wheel he will assist 7 or 9 to run the shell trolley in rear of the breech.

4 and 5 moving the loading stage in rear of the breech.

3 opens the breech.

2 secures the trolley to the gun by the bolt on the former and turns the carrier so that the point of the shell is towards the gun. The Gun Captain releases the catch holding the loading tray. 2, 3, 4, and 5 mount on the loading stage, and ram the projectile home, 3 having removed the safety pin and uncapped the fuze.

The loading tray runs home with the shell. 3 releases and replaces it in the carrier, and unbolts the trolley from the gun. 2 turns the carrier to its travelling position on the trolley.

7 (or 9) moves the trolley to the left of the gun, 2 and 3 extract the cartridges and place them in the chamber, having first removed the mill-board disc from each cartridge.

3 then closes the breech. Before closing the breech, care should be taken to remove any pieces of residue which would be likely to interfere with the closing of the breech or damage the obturating pad.

2 inserts an electric tube in the vent, or 3 a percussion tube, if firing by percussion, as before detailed.

The tube is never to be inserted before the breech is properly closed under any pretext whatever.

At percussion firing, 3 then hooks the lanyard and stands ready to fire.

When all are clear of recoil, 2 gives the word "A 1, Ready." At percussion firing 2 will not give the word "Ready" until 3 has hooked the lanyard and is clear of recoil.

4 and 5 bring the gun to the proper elevation for the range under the orders of the Gun Captain or Gun Layer according to the case employed.

The trolley is removed to the lift from which it was brought by 7 or 9, and, when the ammunition for the next round arrives at the gun floor, is run up to the lift, to which it is secured by 7 or 9 engaging the catch with his foot; he then lowers it to the upper

shelter floor as follows:—He presses down the stop with his foot, and throws the lever over to “*Lower*.” When the lift comes to rest on the first floor, he will release the stop with his foot, and bring back the lever to the vertical position.

Ammunition is brought up alternately from the right and left lifts, unless one lift is disabled.

N.B.—One trolley should always be on the gun floor, in case of the hydraulic gear being disabled, as it is required for loading.

#### TO LAY AND FIRE.

See “Garrison Artillery Training.”

The normal method of firing is by electricity.

The normal means of laying is by rocking-bar sight at long ranges, and by automatic sight when the target is within effective autosight range.

Gun sights will not be used unless the other sights are out of action or not fitted. The tangent sight may have to be removed before firing.

10 traverses, and 4 and 5 elevate, if required to assist.

*Case I (Tangent Elevation).*—Rocking-bar Layer lays for line and traverses; he also lays for elevation, directing the Autosight Layer to elevate or depress, as required, and fires.

Autosight Layer elevates or depresses, as ordered by the Rocking-bar Layer.

*Autosights.*—Rocking-bar Layer lays for line and traverses, and, if ordered to do so, observes and acquaints Autosight Layer with his observations.

Autosight Layer lays for elevation, elevates and fires, and, if ordered to do so, corrects by means of the error of day drum.

*Case II.*—Autosight Layer lays for line, traverses and fires, by order of the Gun Captain, who gives the order at “*on*.”

The Rocking-bar Layer reads dial (when dial is on the mounting), puts on elevation, and gives “*on*” when the gun is correctly layed.

*Case III.*—Autosight Layer reads training dial (when on the mounting), and traverses.

Rocking-bar Layer reads range dial, and elevates.

3 fires by percussion, by order of the Gun Captain, who gives the order at “*on*” from both layers.

#### AFTER FIRING.

As soon as the gun is fired, the Gun Captain removes the firing plug if used; 4 and 5 bring the gun into the loading position without further word of command. At percussion firing, 3 unhooks the lanyard; 3, assisted by 2 if necessary, opens the breech; 4 lays the sponge cloth over the mushroom head, he will not wring it out but place it on as wet as possible; 2 extracts the old tube and attends to the vent. The gun will be at once reloaded.

#### TO UNLOAD AT DRILL.

The gun is unloaded by the numbers who loaded, 7 supplying the cartridge and shell extractors. 3 sees that the loading tray is in the proper position to protect the threads of the breech.

N.B.—Projectiles will not be lowered on the trolleys, but by means of the derrick and winch.



## TO LOAD BY DERRICK.

This method is only used when the hydraulic lifts are not working. The trolley kept on the gun floor is used for the shell.

## FOR ACTION, UNDER COVER, MISSFIRE, CEASE FIRING, REPLACEMENT OF CASUALTIES.

See "Garrison Artillery Training."

The positions under cover are as follows:—

- 2, 4, Antosight Layer and Gun Captain on the right of the gun.
- 3, 5, and Rocking-bar Layer on the left of the gun.
- 6 and 8 at the cartridge hatch.
- 7, 9, and 10 at the ammunition lifts.

The procedure at "Missfire" being called will be as follows:—

*Electric Firing.*—After a pause of three minutes, 4 and 5 elevate the gun sufficiently for the lock to be reached from the gun floor, 2 inserts a new tube. Should a missfire again result, a change will be made to percussion firing, after a further pause of three minutes, as follows:—

4 and 5 again elevate, 2 removes the electric lock, 3 inserts percussion lock and tube, hooks lanyard and stands ready to fire.

NOTE.—When changing from percussion to electric firing, a similar procedure is followed.

## TO CEASE FIRING AND REPLACE STORES.

The gun is left depressed by 4 and 5. The stores are replaced by the numbers who brought them up.

The detachment then falls in at "Detachment Rear."

## DRILL FOR 9·2-INCH B.L. GUNS, MARKS X AND X<sup>v</sup> ON MARK V MOUNTING.

The detachment consists of a Gun Captain, Gun Layer, and ten other gun numbers, and an additional Gun Layer from the 50 per cent. spare. It falls in and is told off in the usual manner.

For the duties of Gun Captain and Gun Layer, see "Garrison Artillery Training."

## AMMUNITION SUPPLY.

Cartridges are supplied from recesses (or depôts if required) by hand to the gun. Supply may also be made to the level of the emplacement by lift.

Projectiles are supplied from recesses in the emplacement and from depôts, which should be arranged round the emplacement, and thence by hydraulic gear, when fitted, to the gun platform. Supply may also be made to the level of the emplacement by lift.

The normal supply of ammunition will be from the recesses or depôts. In this case 6 and 8 supply cartridges to 3 and 5 on gun platform, 10 and 11 load a projectile on projectile barrow, 11 fuzes it (if necessary) and takes it to the front hoist or under derrick

hatch, 7 and 9 proceed to front hoist and raise projectiles on to trolleys, 7 attending to the control lever of hoist, 9 to the trolleys. 7 is responsible that the straps are properly pinned up before lowering the hoist.

When supply is from lifts, 6, 7, 8 and 9 work in a similar manner, 10 and 11 roll shell from the lift on to barrow, remove grummetts, if not already done, and fuze shell and take them to front hoist.

Lids of cylinders will be removed at bottom of cartridge lift before sending up.

Empties will be stacked by 6 and 8 without obstructing the working numbers at the gun.

As the recesses only hold a limited number of rounds it will be advisable not to reduce the total for each gun below six, but when this point has been reached to change to lift supply.

In addition to the above detail, when guns are served by lifts direct from both shell and cartridge stores, nine additional numbers will be required to supply and work the lifts.

If only one lift is provided, three of these numbers should be detailed to carry cartridges in cylinders to cartridge recess or depôt direct, the lift being reserved for shell only.

#### TO PREPARE FOR ACTION.

See "Garrison Artillery Training."

Stores are brought up as follows from the group store:—

Gun Captain.—A piece of chalk, key of firing plug box, pressure gauge No. 1, and necessary spanners.

Gun Layers.—Sights, lock, slide box, pistol grip, screw-driver, and convergence table.

2.—Tubes, tube box, pocket gun-layers, vent bit, rimer, wrenches, breech and firing mechanism, oil can, Russian tallow, waste, spanners (buffer and McMahon). For drill, a drill tube.

3.—Percussion lanyard and stop for use in loading tray.

4.—Brush-rammer-and-sponge, bucket filled with water, brush, and sponge cloth.

5.—Loading tackle and box of spare parts.

6 and 8.—Keys of cartridge and shell recesses and of lifts (if necessary). For drill, cartridges in zinc cylinders and cartridge extractor.

7 and 9.—Projectile barrows and brush, selvagee, two keys fuze universal, two keys base fuze and plug when required, grease box, 10 bolts, eye, lifting, driver grummet, mallet tinman's. For drill, a drill shell and shell extractor.

10.—Elevating wheel, and assists 7 and 9.

11.—Traversing wheel, and assists 7 and 9.

The following group stores will be brought up, and such other stores as are considered necessary locally:—

Hammer	...	...	...	1 per group.
Clinometer	...	...	...	1 per work.
Broom	...	...	...	1 per group.
Extractor tube, special, box,				
slide A	...	...	...	1 per 2 guns.
Whistle	...	...	...	1 per group.
Instrument, testing, primary				
batteries	...	...	...	1 per work.
Drivers, screw	...	...	...	2 per work.

When the stores are brought up the Gun Captain gives "A 1, Prepare for Action" and satisfies himself that the buffer is properly connected up, not leaking at the glands, and contains the correct amount of oil and air pressure, that the accumulator is filled with liquid, and that the capsquares are properly secured.

He places his stores in a convenient position for use, and when the breech is opened he looks to see that the bore is clear.

He sees that the ammunition is properly prepared. He superintends the firing of an electric and a percussion tube to test firing arrangements.

The Autosight Layer, assisted where necessary by the Rocking-bar Layer, fixes the sights on the cradle, and sees that they work and fit properly, and that the sight carriers are firmly attached to the mounting, tests autosights, makes the necessary connections, and tests the firing circuit; he examines the lock and places it in position in the slide box on the vent, and fires a tube after the breech is closed when ordered to do so by the Gun Captain. He sees that the elevating and traversing gears are oiled and in working order.

3 removes the muzzle cover. He prepares to hook lanyard and fires a tube when ordered to do so by the Gun Captain.

2 attaches the tube boxes and layer's pocket to the mounting, placing some tubes in the tube boxes, and the remainder in a convenient position for use. He places the oil can, tallow and waste on the mounting under the breech on the right side and the spanners outside the side shield. He then puts the lever of the rear hoist at "Lower."

2 now opens the breech by taking hold of the breech mechanism lever with his right hand and pulling it towards him as far as it will come. This unlocks and withdraws the breech-screw. He then passes the vent bit down the vent, examines the breech-screw and threads of the breech, sees that they are clean and free from burrs, lubricates the threads with a slight film of oil and smears the obturating pad with Russian tallow. He then inserts a tube, pushing it well home, and cocks the lock if percussion tubes are used.

To close the breech, 2 takes hold of the lever with his left hand, and pushes it away from him with a continuous and deliberate motion as far as it will go; this prepares for electric firing. If difficulty is experienced in closing the breech, 5 will assist 2 to force the lever home, but when once the motion of closing the breech has commenced the lever must on no account be partially drawn back to obtain a fresh purchase. If the lever be drawn back after the motion of closing the breech has commenced, the tube is partially extracted; any subsequent forward motion of the lever tends to damage the tube by causing the extractor to foul that portion of it which projects from the vent. If the percussion tube be bent within 0.9 inch of the head, the detonating composition is liable to be fired, resulting in a premature explosion of the charge.

NOTE.—Whenever the breech is closed without inserting a tube, the extractor should be pressed well home before closing. Under no circumstances should the lock be snapped unless a tube is in the vent. Should it be necessary to ease springs, it should be done gently by hand.

As soon as the breech is closed 2 puts over the contact lever and gives "A 1, Ready."

After the tube is fired, **2** opens the breech, rimes out the vent, and closes the breech again.

**4** places the brush-rammer-and-sponge, the bucket filled with water, and brush in rear of the gun.

**5** assists the Gun Layer, hooks the hoisting tackle if not already fixed, overhauls and secures it, and passes the running end down to **9** and **10**, who make it fast to the winch.

**6** and **8** go to the cartridge recess or lift, and prepare to issue cartridges. For drill they place drill cartridges and extractor in convenient positions for use.

**7, 9, 10,** and **11** go to the shell recess, depôt, or lift (if supply is by lift), and prepare shell for loading, *i.e.*, clean and fuze them, if not already done, and remove plugs from eyebolt holes of lyddite shell, and screw in eyebolts. For drill they place the drill shell and extractor in convenient positions for use. **7** hands a fuze key to **3**, and puts the lever of front hoist to "Lower." As soon as they find out the nature of projectile to be used, they act as previously detailed, and fill the trolleys.

**10** fixes the elevating wheel, and takes post to elevate if required.

**9** passes the filled trolley over the rear hoist, fixes the traversing wheel, and takes post to traverse if required.

Each number will report to the Gun Captain any damage or deficiency.

After each number has completed his work, he takes post as follows:—

Gun Captain in the most convenient position.

Gun Layers on the sighting steps in rear of the sights.

**2** on the right of the gun facing the breech.

**3** on the left of the gun facing the breech.

**4** on the left of **2**.

**5** on the right of **3**, or at the loading tackle.

**6** and **8** on landing of staircase, outside cartridge recess, or at head of lift.

**7** and **9** at front hoist, depôt, recess, or lift.

**10** and **11** at depôt, recess, or lift, or at elevating and traversing wheel as ordered.

#### TO LOAD.

NOTE.—The gun may be loaded between 5 degrees elevation and depression. The Gun Captain is responsible that the gun is in the proper position.

Gun Group Commander.

Gun Captain.

"A Group ..... Load."

"A 1 ..... Load."

**2** opens the breech, then seizes the handle of control lever of rear shell hoist, and looks towards the Gun Captain.

**3** swings loading tray round in rear of breech.

**9** runs trolley round with shell over rear hoist, taking care that the clip on shell pit shield rests on recess in trolley.

The Gun Captain now raises his right arm as a signal to **2** to raise the shell, and when high enough lowers his arm\*; **2** places the lever to "Raise," bringing it back to the centre just before the shell

\* In the absence of the Gun Captain these signals will be given by **3**.

is high enough, then again moves it slowly towards "Raise," bringing it at once to centre as the Gun Captain signals "*High enough.*" He must be careful not to raise the shell too fast, or the hoist tray will come violently against the loading tray and damage the ram and hoist.

3 removes safety pin and cap from fuze when the projectile has reached the loading position. (H.E. shell only). He also removes eyebolt from lyddite shell, and passes it to 9.

4 places saturated sponge cloth over mushroom head, and supplies himself with the brush-rammer-and-sponge, and places the head against the base of the projectile; the stave is rammed by 3, 4 and 5, who run forward, thus ramming home. As soon as the projectile is home, 3 and 5 quit the rammer stave, 4 withdraws the brush-rammer-and-sponge, dips the sponge head in water, and stands ready to ram the next round.

NOTE.—The sponge head must be thoroughly saturated with water after each round.

When the shell is clear of the hoist the Gun Captain signals "*Lower*" by motioning with his hand in a downward direction; at this signal 2 puts the lever to "*Lower*"; then rimes out the vent, and, if necessary, uses the vent bit. He then inserts a tube, and at percussion firing, cocks the lock.

6 and 8 each withdraw a cartridge from a cylinder at the recess or depôt and supply them to 3 and 5 with millboard discs removed, placing themselves in the most convenient position to do so.

3 places the first cartridge in the chamber, and then swings the loading tray clear, and at percussion firing prepares the lanyard; 5 places in the second, then removes sponge cloth, and throws it into the bucket.

10 and 11 supply 7 with projectiles, 9 will always keep a shell over the rear hoist when the latter is down (except when the hinged doors are open on account of elevation extending 7°), and see that the trolley is properly secured by the clip on the shell pit shield. He will also push round the empty trolley. Trolleys will always be kept moving "with the clock."

2, assisted by 5, then closes the breech, as previously detailed. At percussion firing 3 then hooks the lanyard and stands ready to fire.

When all are clear of recoil \* 2 puts over the contact lever at electric firing, standing outside the side shield to do so, and gives the word "*A 1, Ready.*" At percussion firing 2 will not give the word "*Ready*" until 3 has hooked the lanyard and is clear of recoil.

At Deliberate and Group Fire the circuit will not be completed at the Auto Circuit Breaker until the G.G.C. has given "*Commence Firing.*"

NOTE.—At percussion firing it is most essential that the lock be cocked before closing the breech, otherwise there is great danger of the tube being fired prematurely owing to the pressure of the striker over the head of the tube.

Before closing the breech care should also be taken to remove any pieces of residue which would be likely to interfere with the closing of the breech or damage the obturating pad.

---

\* All numbers must be careful to keep clear of the lower elevating wheel, as it is liable to fly round rapidly when the gun is fired.

## TO LOAD BY DERRICK.

This method is only used when the hydraulic lifts are not working.

On the command by Gun Captain "*Derrick Loading*" 2 keys up the lever at the central position, the Gun Captain being responsible that this is done. 3 places stop in loading tray.

10 and 11 run the projectile on barrow underneath the derrick hatch with selvagee or eyebolt fixed. With lyddite shell, eyebolts will invariably be used. If there are shells on the trolleys 9 runs a trolley under the hatch; 7 raises the winch brakes, 3 and 5 overhauled the tackle, 7 assisting with the winch handle. 3 passes the lower block to 9, who hooks it into eyebolt or bight of selvagee; 7, 10 and 11 man winch handle, and on signal "*Raise*" from 9, hoist the shell. 9 steadies the projectile; 3 and 5 then steady it, and swing it over the loading tray. The Gun Captain gives "*High enough*," followed by "*Lower*"; 7 raises the brake, and 10 and 11 ease off. 3 swings round the loading tray, and 5 unhooks the tackle; 3 unscrews the eyebolt or removes selvagee and passes it to 9. Loading then proceeds as for hydraulic loading, after which 5 overhauls the tackle and swings back the derrick.

The shell numbers will change rounds when required at the discretion of the Gun Captain.

## TO LAY AND FIRE.

See "*Garrison Artillery Training*."

The normal method of firing is by electricity.

10 elevates and 11 traverses if required to assist.

*Case I. (Tangent Elevation).*—Rocking-bar Layer lays for elevation, elevates and fires. (The Gun Captain should, if possible, act as setter.)

Autosight Layer lays for line and traverses.

*Autosights.*—Rocking-bar Layer lays for line and traverses, and, if ordered to do so, observes and acquaints Autosight Layer with his observations.

Autosight Layer lays for elevation, elevates and fires, and, if ordered to do so, corrects by means of the error of day drum.

*Case II.*—Autosight Layer traverses and fires by order of Gun Captain, who gives the order at "*on*."

The Rocking-bar Layer reads dial (when dial is on the mounting), puts on elevation below, and gives "*on*" when the gun is correctly layed.

*Case III.*—Autosight Layer reads training dial (when on the mounting) and traverses. Rocking-bar Layer reads range dial and elevates.

3 fires by order of the Gun Captain, who gives the order at "*on*" from both layers.

## AFTER FIRING.

As soon as the gun is fired 3 unhooks the lanyard if used, 2 opens the breech. The gun will be at once reloaded.

**NOTE.**—In order to keep the mushroom head of the obturator from becoming too hot, it will be necessary to utilise every interval in the firing for cooling it by the application of thoroughly saturated cloths.

The white metal disc of the obturator must be watched for any signs of fusion, and if the metal should begin to melt the firing ought to be suspended for 30 seconds in order to cool the mushroom head. Firing can then be resumed, but it would be more satisfactory to change the axial vent and discs.

## TO UNLOAD AT DRILL.

The gun is unloaded by the numbers who loaded, 6 supplying the cartridge extractor, 7 the shell extractor; 3 sees that the loading tray is in the proper position to protect the threads of the breech.

NOTE.—The projectile must be removed from the loading tray, and lowered by the derrick, and not by the hoist, as pulling the shell out of the loading tray on to the hoist is liable to bend the ram.

FOR "ACTION," "UNDER COVER," "MISSFIRE," "CEASE FIRING,"  
"REPLACEMENT OF CASUALTIES," "DETACHMENT REAR."

See "Garrison Artillery Training."

*To Change Tube in Case of Missfire.*—The Gun Captain gives "Stand Clear" and sees that no one is in a position where he might be struck by the tube if it should be blown out by a bang fire. Then, without making any pause, he cocks the lock by lanyard, hooks the percussion lanyard to the guide bolt of link actuating lock, and pulls to the rear and to the right, when the lock will travel to the right, and eject the tube.

If the tube has not fired a new tube can be inserted. In the case of electric firing the spring must be eased before inserting the tube.

If the tube has fired the breech will be opened after a pause of three minutes, and charge readjusted if necessary.

Should the second tube fail to fire, in case of percussion firing, the lock will be changed, and in the case of electric firing, resort will be made to percussion firing under the same precautions as detailed above.

The positions under cover are as follows:—

2, 4, Autosight Layer and Gun Captain on the right of the gun.

3, 5, and Rocking-bar Layer on the left of the gun.

6 and 8 at cartridge lift, recess, or depôt.

7, 9, 10, and 11 at shell lift, recess, or depôt. All sitting or kneeling.

## TO CEASE FIRING AND REPLACE STORES.

The gun is depressed about 4 degrees, and the stores are replaced by the numbers who brought them up. The detachment then falls in at "Detachment Rear."



## ALTERATIONS.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

Para. of List of Changes.	Nature of Change.	Remarks.

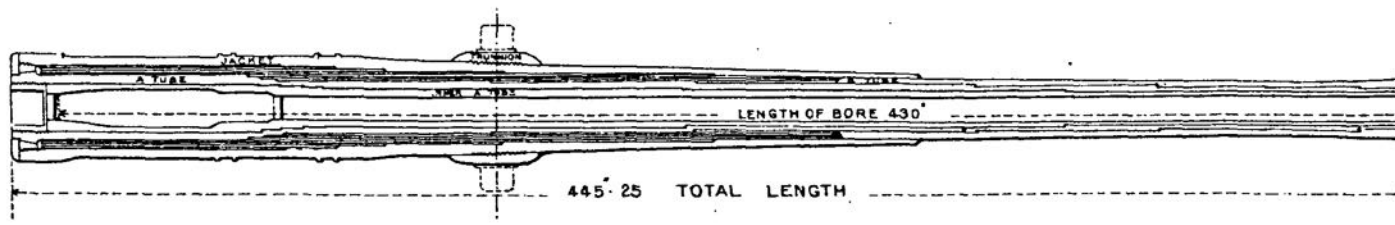
LONDON:  
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,  
BY HARRISON AND SONS, ST. MARTIN'S LANE,  
PRINTERS IN ORDINARY TO HIS MAJESTY.

(Wt. 4967 4500 G |·0G 9389)

ORDNANCE, B.L., 9.2 INCH, (WIRE). MARK IX.

27 TON.

SCALE  $\frac{1}{80}$ .

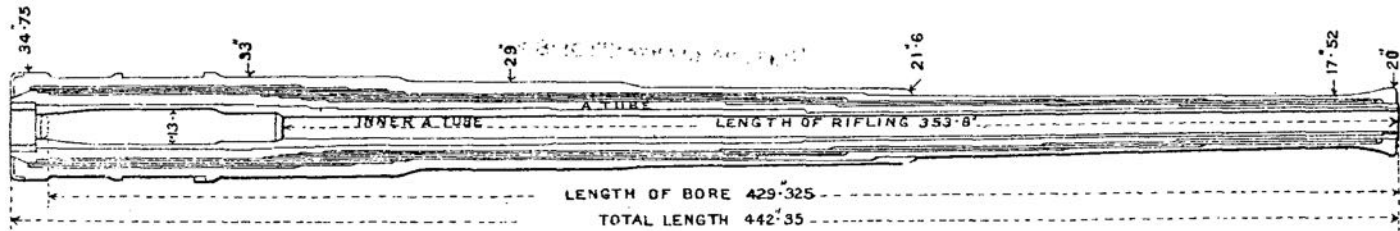




ORDNANCE, B. L., 9.2 IN. (WIRE,) MARK X.

STEEL. 28 TON.

SCALE  $\frac{1}{60}$ .



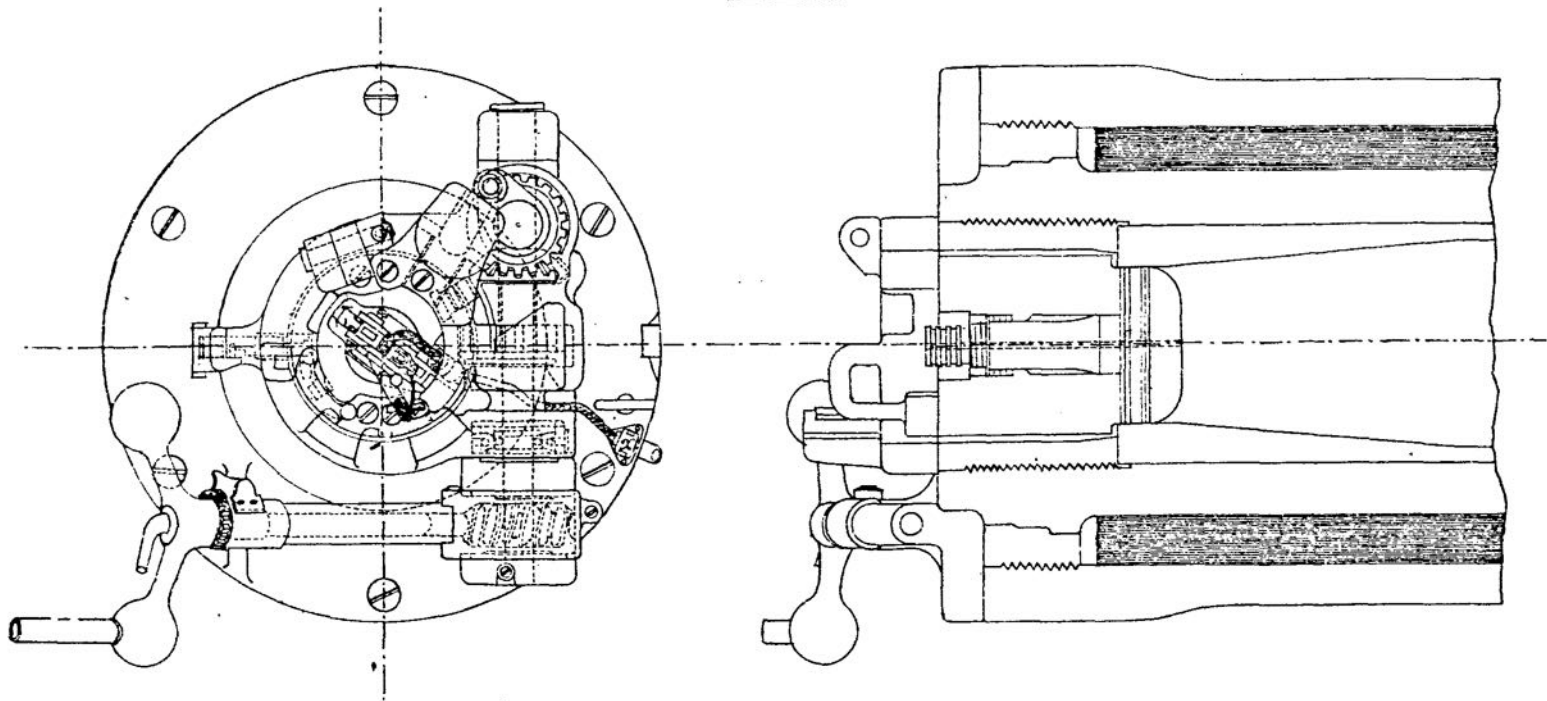
Weller & Graham, L., Litho. London.

Plate II.

ORDNANCE, B. L. 9.2 INCH, (WIRE.) MARK IX.

GENERAL ARRANGEMENT OF BREECH MECHANISM

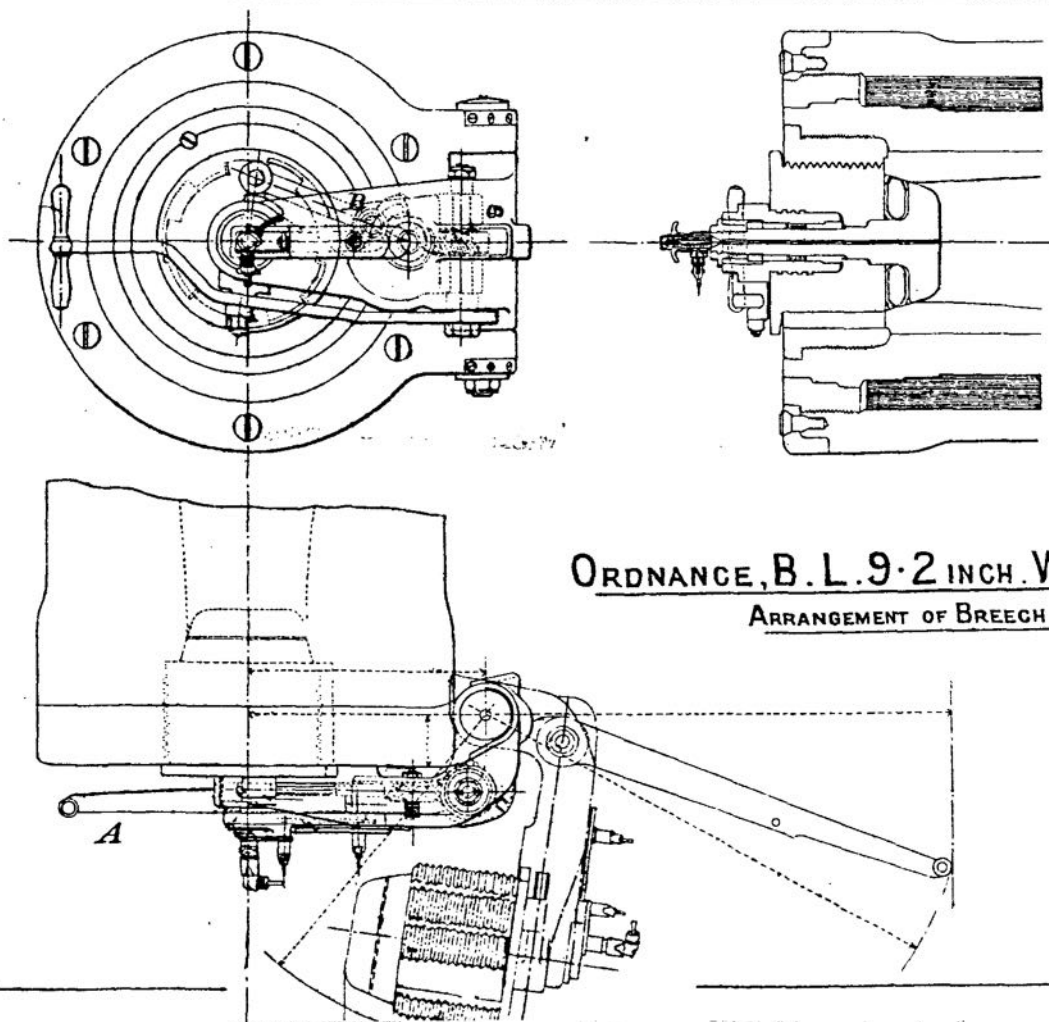
SCALE  $\frac{1}{12}$



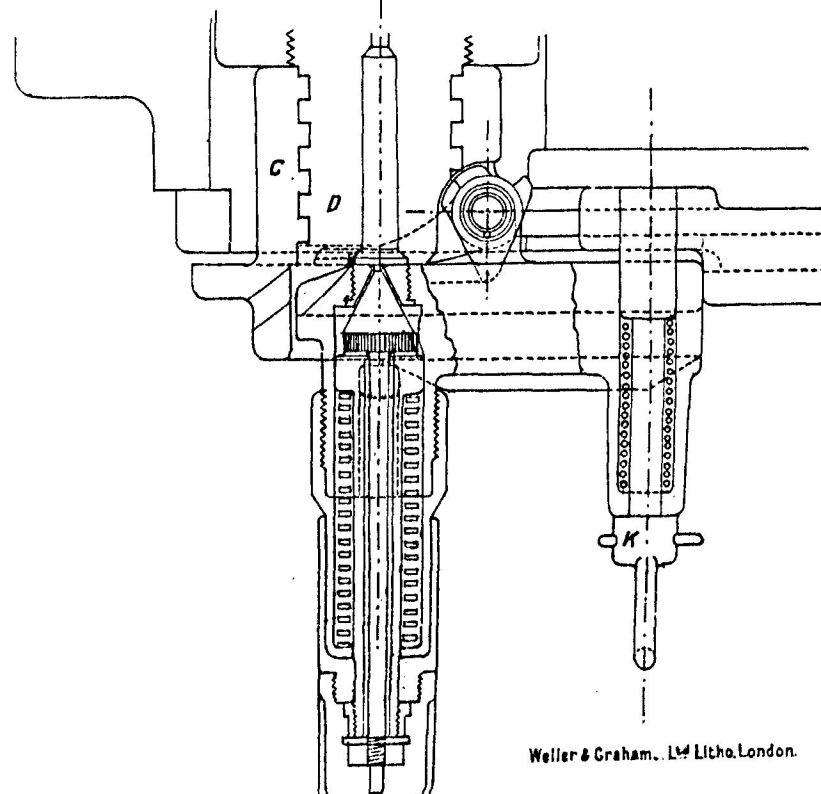
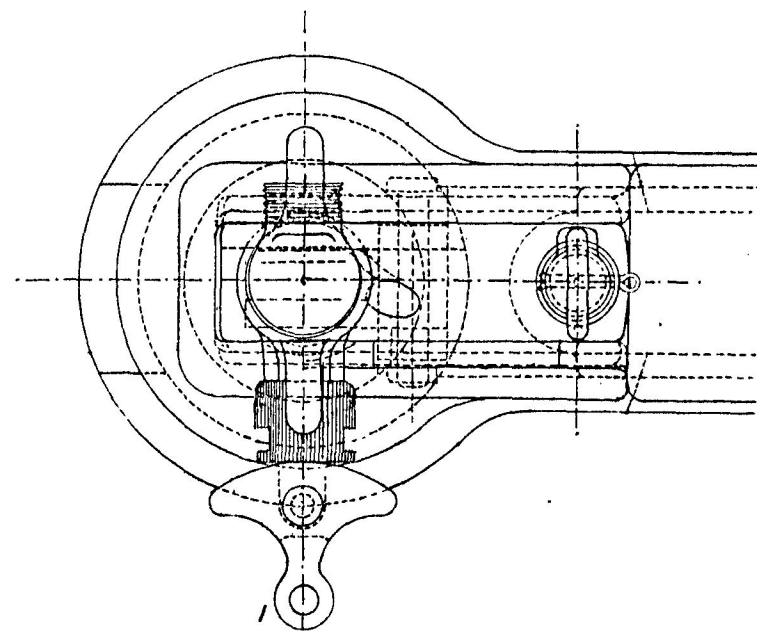
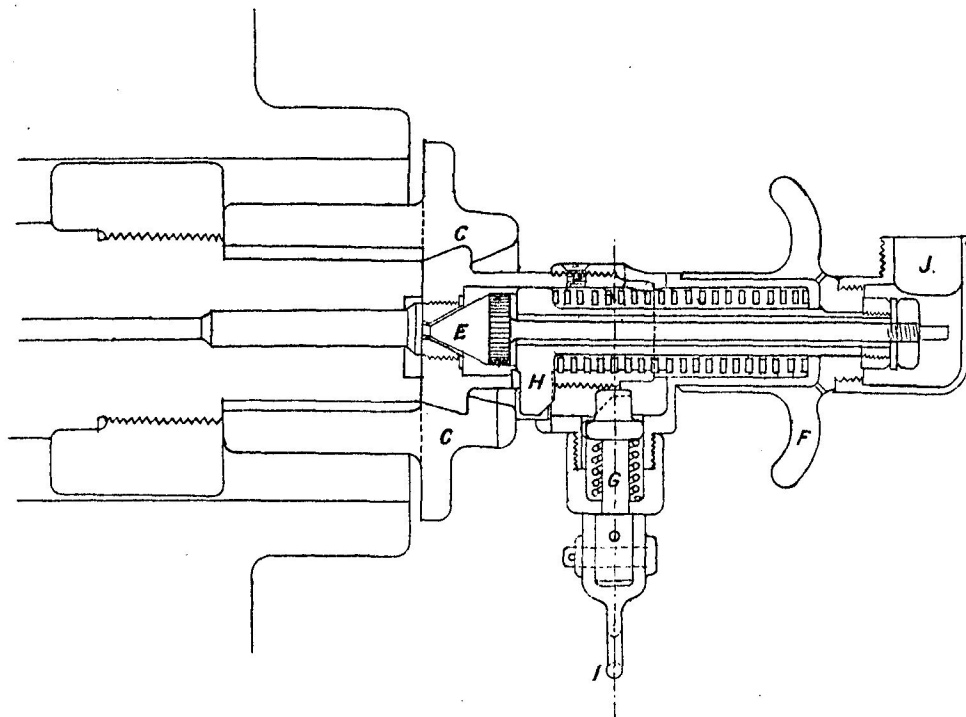
5493, .05.

Mellor & Graham Ltd Litho London.

Plate III



ORDNANCE, B.L. 9.2 INCH. WIRE, MARKS X & X<sup>c</sup>  
ARRANGEMENT OF BREECH MECHANISM.



ORDNANCE, B. L., 9.2 INCH, M<sup>KS</sup> X AND XV

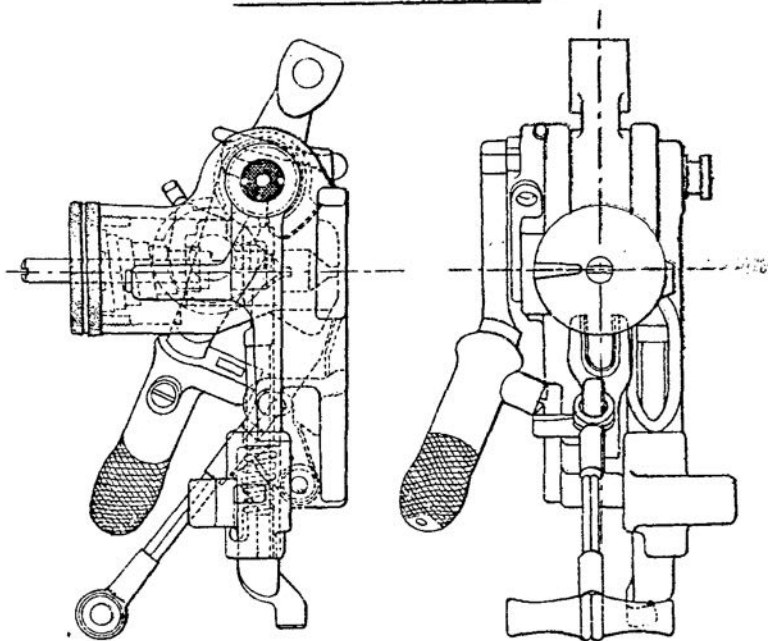
LOCK, ELECTRIC & PERCUSSION, "E".

SCALE 1/2.

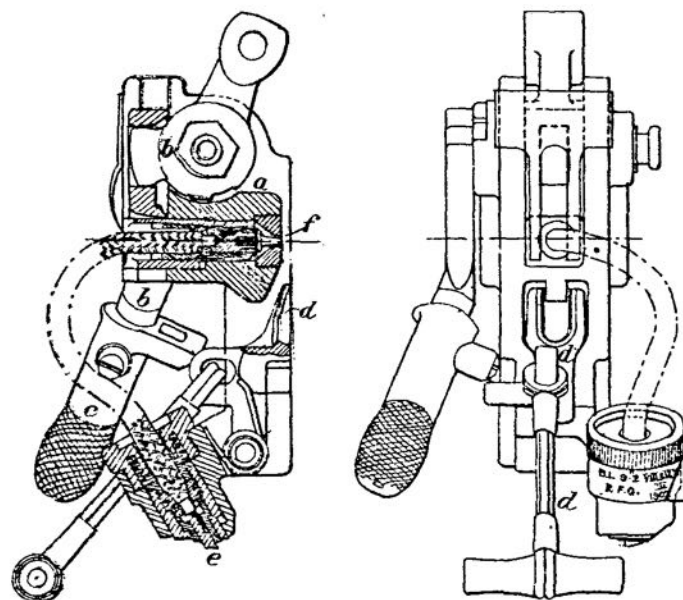
# ORDNANCE, B.L., 9.2 INCH (WIRE) MARKS VIII & IX.

SCALE  $\frac{1}{3}$ RD.

LOCK PERCUSSION.



LOCK ELECTRIC (MARK III).



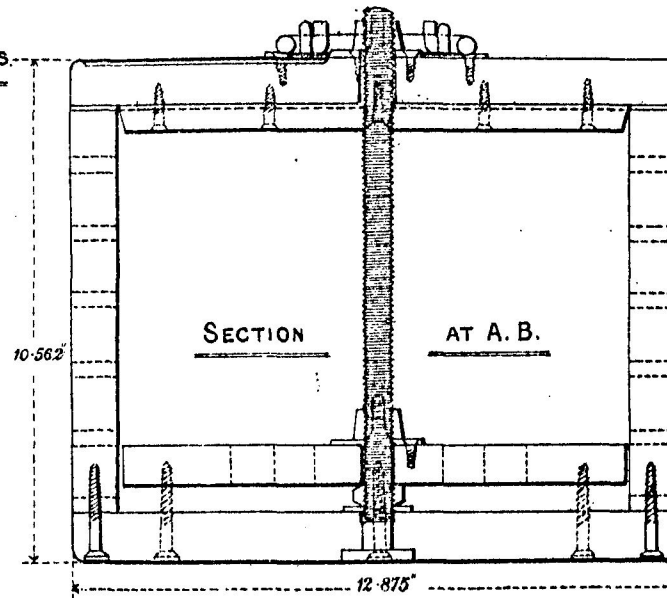
BOX, OBTURATING PADS AND DISCS, B.L. 8 INCH & 9.2 INCH, MKS. VIII & IX GUNS (MK III)

WOOD, WITH GUN METAL BOLT AND FLY NUTS TO HOLD 3 PADS & 3 SETS OF DISCS.

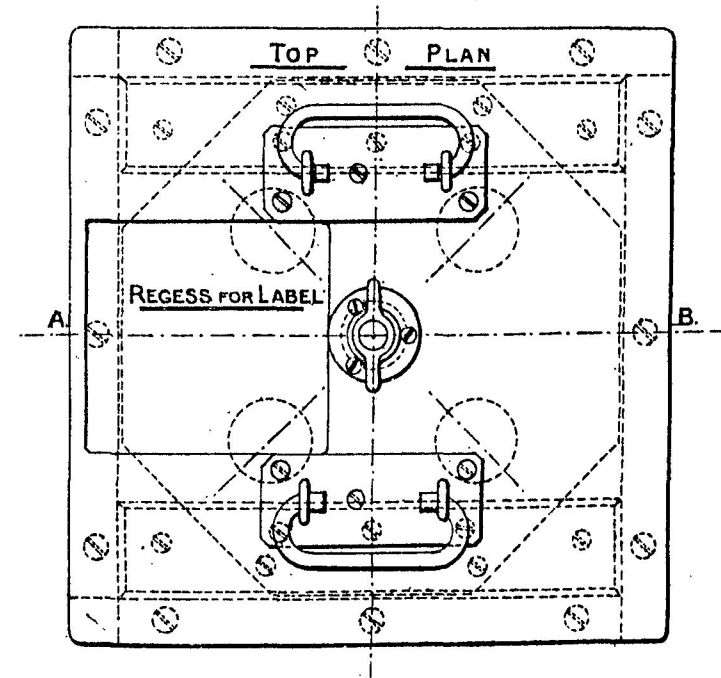
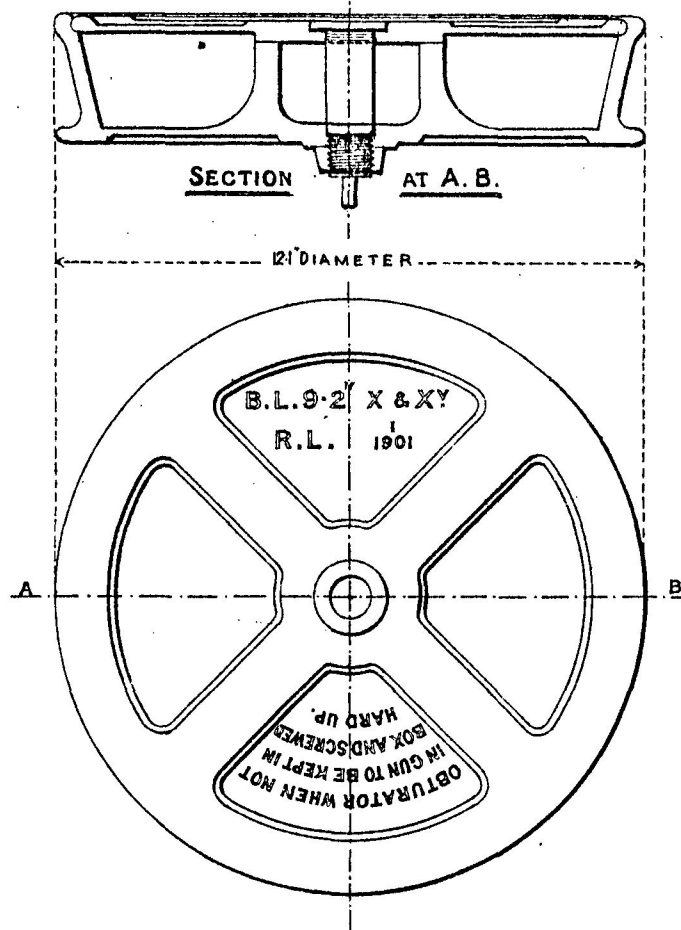
BOX, OBTURATOR STEEP CONED, B.L. 9.2 INCH (MARK I)

BRONZE; TO HOLD OBTURATOR & ONE ADJUSTING DISC, MKS. X & XY GUNS.

SCALE  $\frac{1}{4}$ .

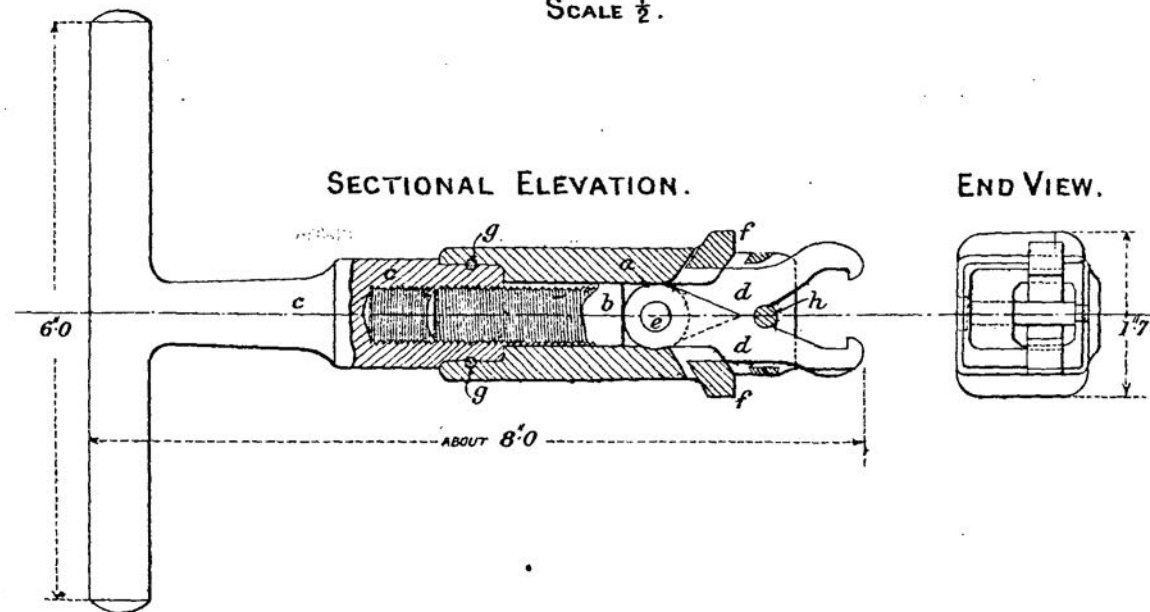


SCALE  $\frac{1}{4}$ .



EXTRACTOR, TUBE, SPECIAL BOX, SLIDE, "A" (MARK I).

SCALE  $\frac{1}{2}$ .





# RIFLE, AIMING, 1 INCH, ELSWICK, "B" (MARK I)

GENERAL ARRANGEMENT FOR  
9.2 INCH B.L. GUN. MARK IX, X, & XV

SCALE 1/5

SECTION THRO D.C.  
SHEWING STRIKER AT FULL COCK

END ELEVATION

REAR ADJUSTING DISC  
SHEWN IN COCKED POSITION  
STRIKER & COVER IN FIRING  
POSITION

PLAN

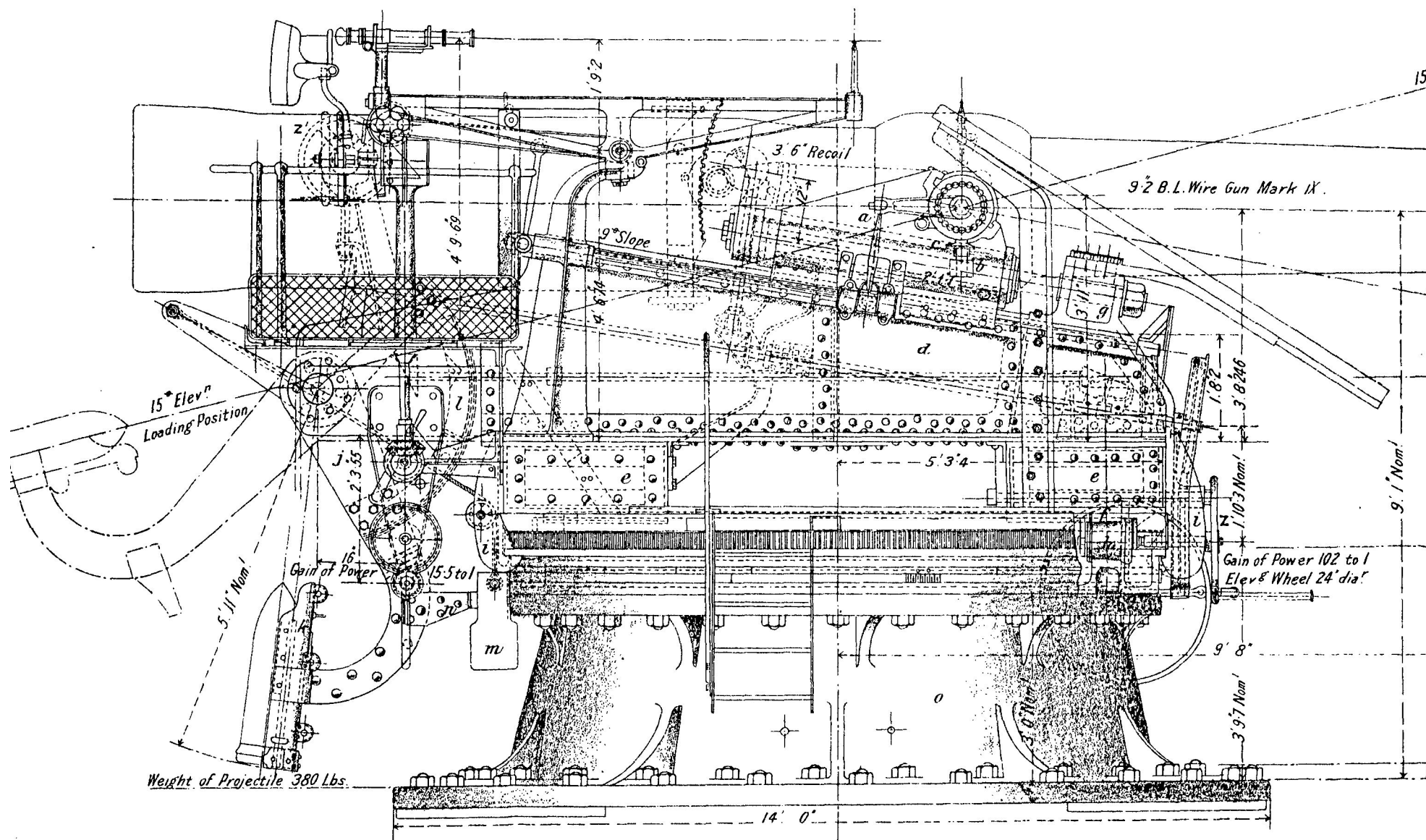
SECTIONAL PLAN

SECTION THRO  
E.F.

SECTION THRO  
G.H.

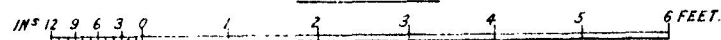
# CARRIAGE, GARRISON, BARBETTE, B. L., 9.2 INCH, MARK III.

## SLIDE, L, BARBETTE, B. L., 9.2 INCH, MARK III.



SIDE ELEVATION.

SCALE.



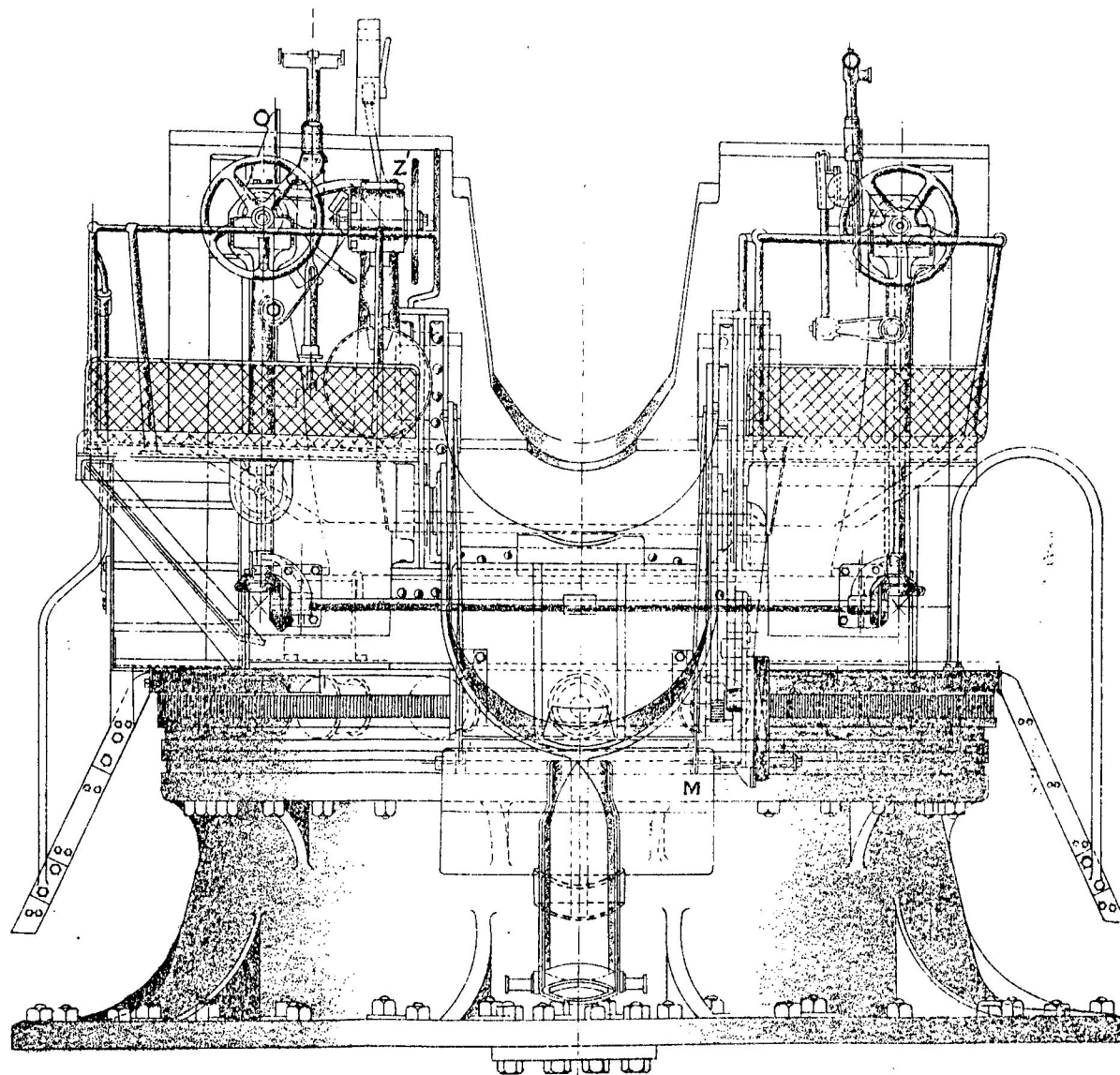
SLIDE, L, BARBETTE, B. L., 9.2 INCH, MARK III.



SCALE.

CARRIAGE, GARRISON, BARBETTE, B. L., 9.2 INCH, MARK III.

SLIDE, L, BARBETTE, B. L. 9.2 INCH, MARK III.



REAR END VIEW.

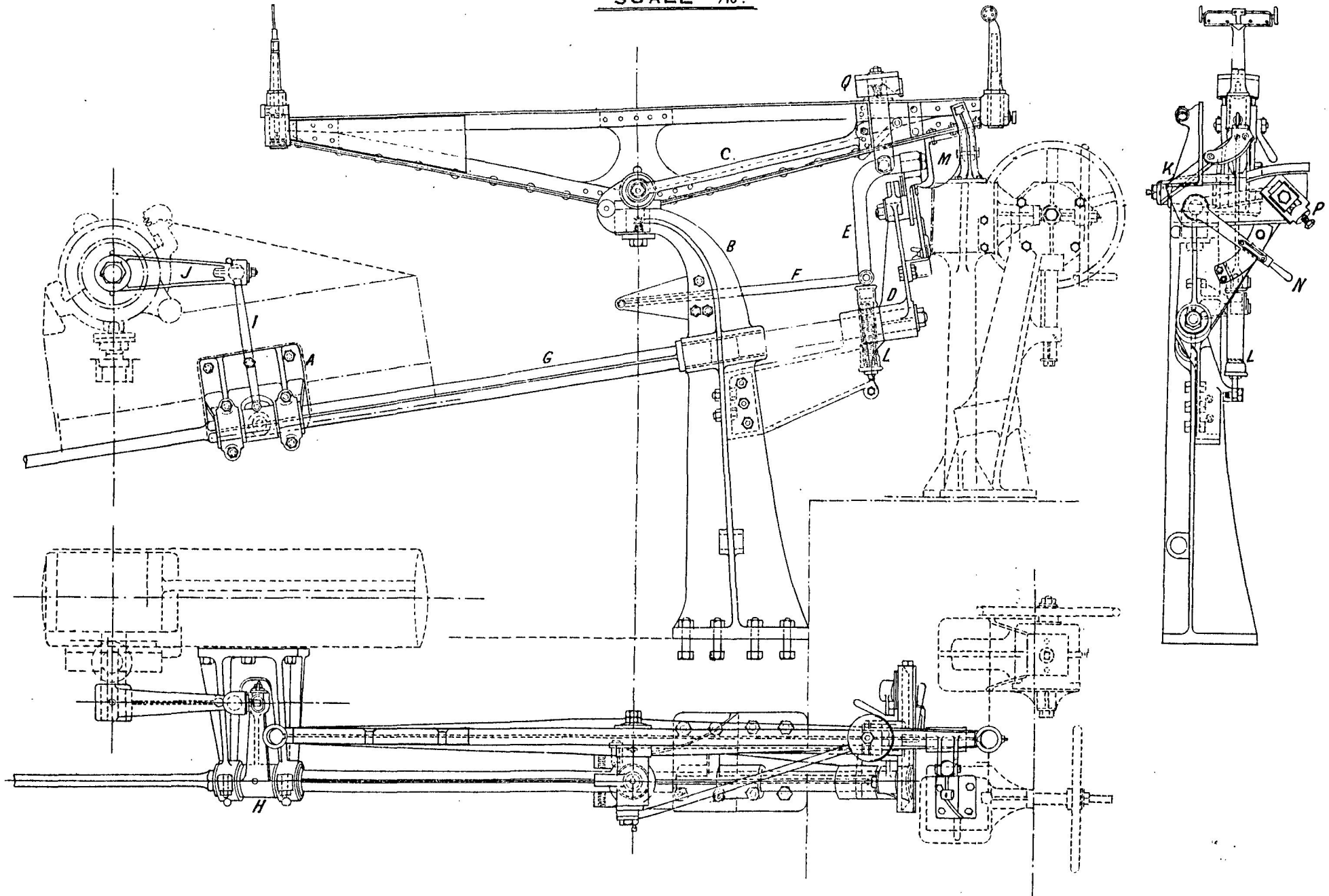
SCALE.

INS 12 9 6 3 0 1 2 3 4 5 6 FEET.

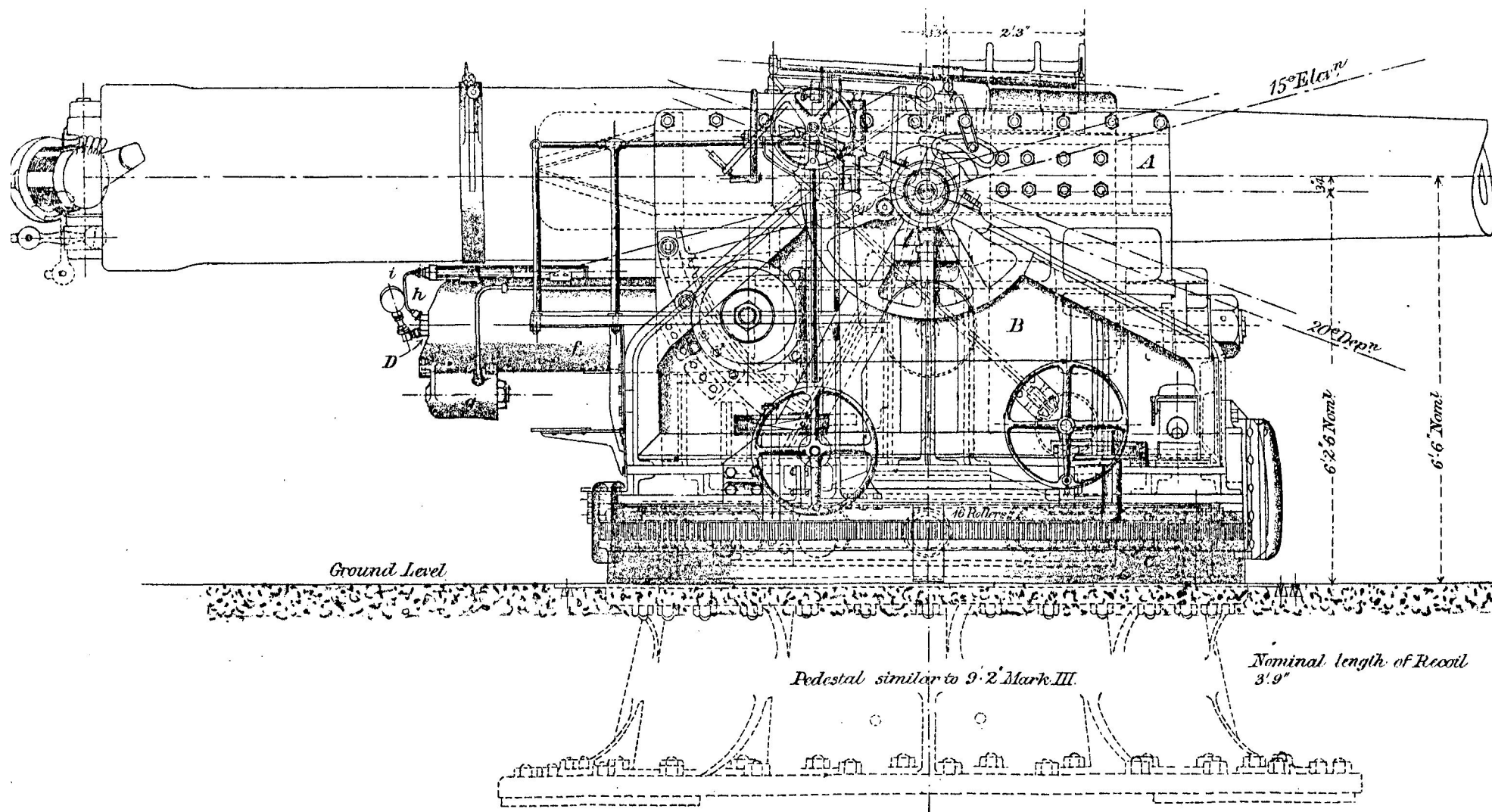
SLIDE, L, BARBETTE. B. L, 9.2 INCH, MARK III.

GENERAL ARRANGEMENT OF AUTOMATIC SIGHTS LEFT HAND SIDE.

SCALE 1/16.



CARRIAGE GARRISON, BARBETTE, B.L. 9.2 INCH, MARK IV.

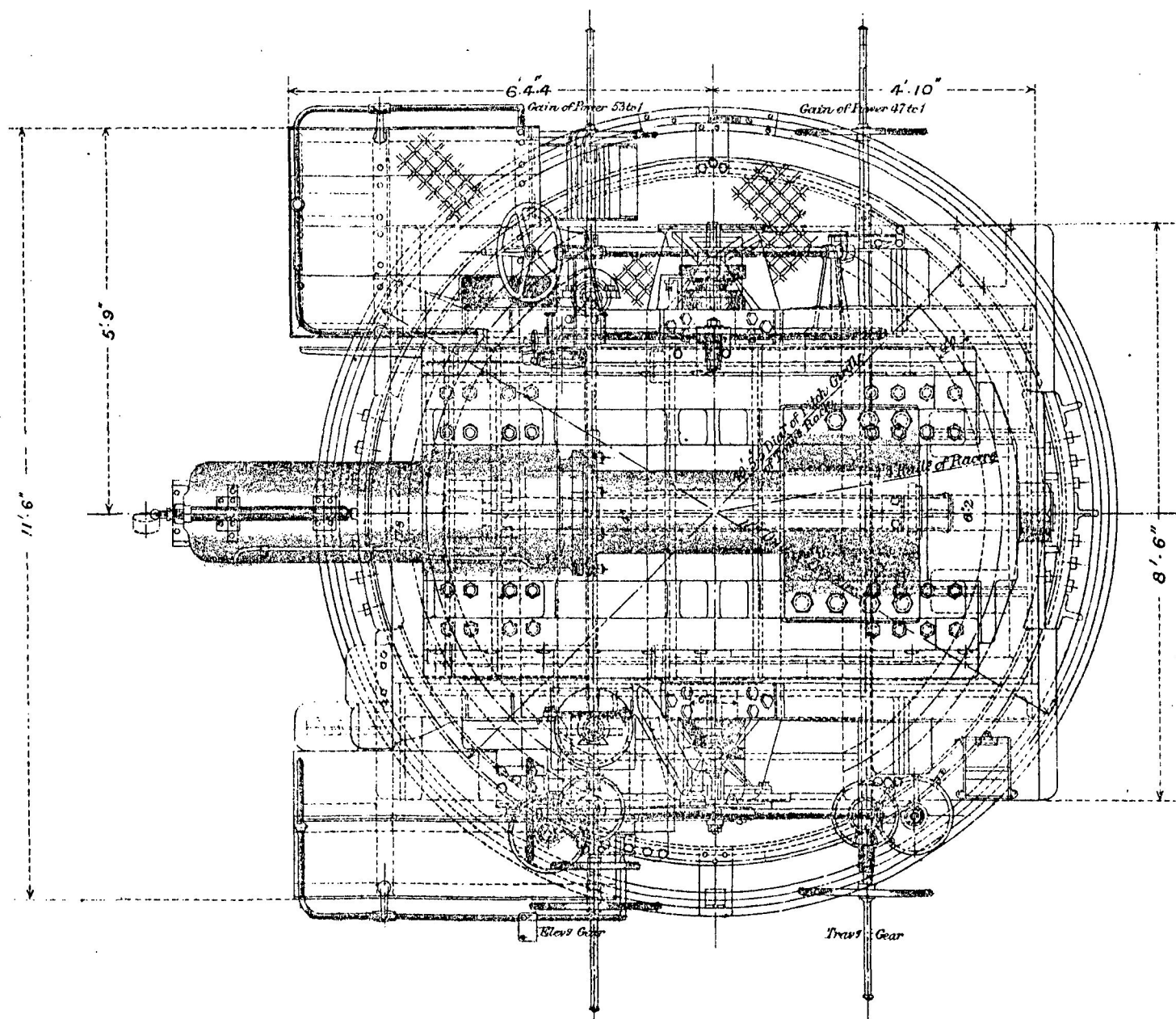


SIDE ELEVATION.

SCALE.



CARRIAGE, GARRISON, BARBETTE, B. L. 9.2 INCH. (MARK IV) L.

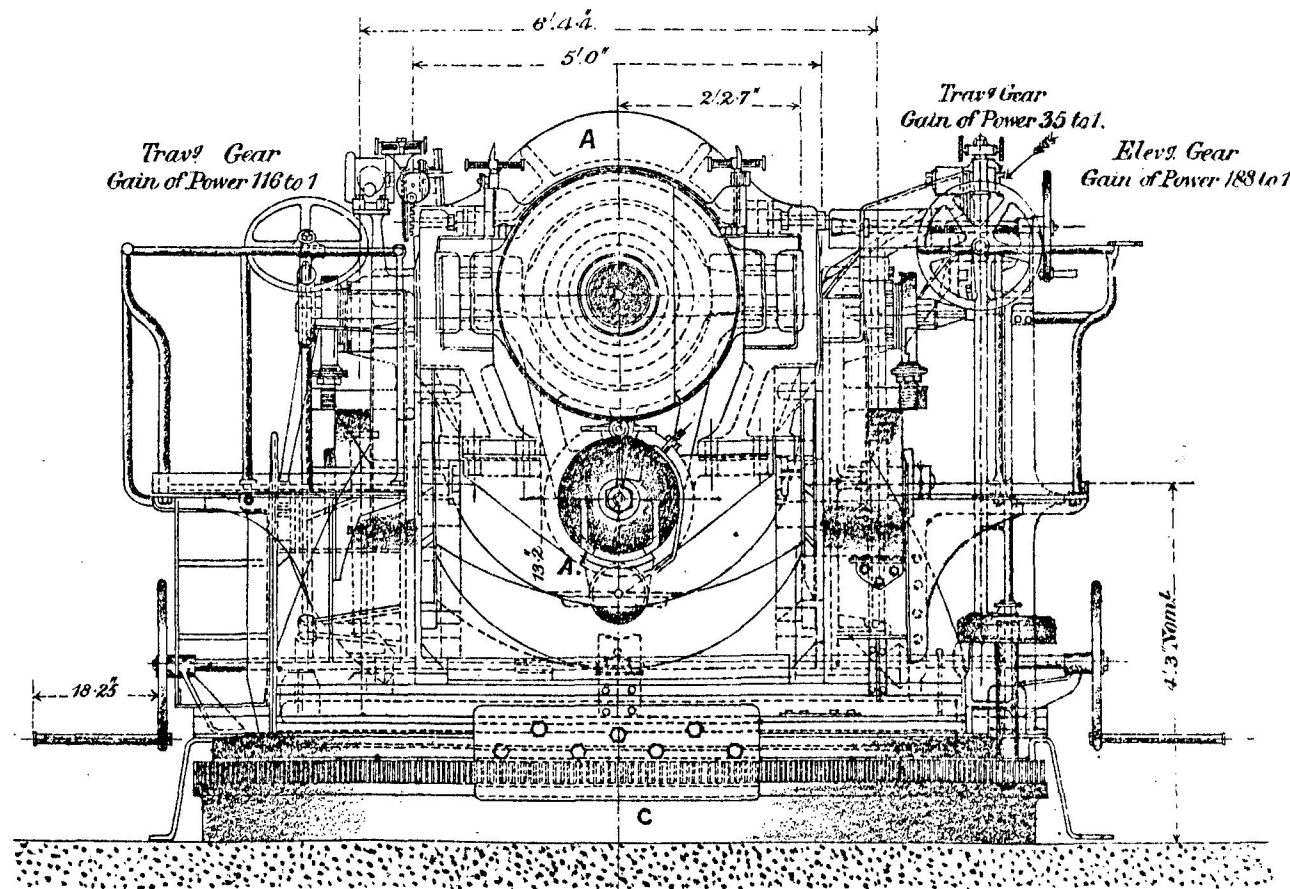


— TOP PLAN. —

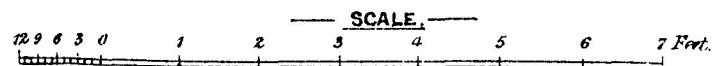
SCALE.



CARRIAGE, GARRISON. BARBETTE, B.L., 9.2 INCH, MARK IV.



REAR END VIEW.



AMENDMENTS TO HANDBOOK  
OF THE  
9·2-INCH B.L. GUNS, MARKS IX, X,  
AND Xv.

(LAND SERVICE.)

1906.

PUBLIC LIBRARY OF VICTORIA

Page 123, line 3.

*For* "a gun layer" *read* "two gun layers."

Page 123, line 4.

*Delete* "and an additional layer from the 50 per cent. spare."

Page 123, line 6.

*For* "gun layer" *read* "gun layers."

Page 127, line 5 from bottom.

*For* "a gun layer" *read* "two gun layers."

Page 127, line 4 from bottom.

*Delete* "and an additional layer from the 50 per cent. spare."

Page 127, line 2 from bottom.

*For* "gun layer" *read* "gun layers."

Page 132, line 28.

*For* "a gun layer" *read* "two gun layers."

Page 132, line 29.

*Delete* "and an additional gun layer from the 50 per cent. spare."

Page 132, line 31.

*For* "gun layer" *read* "gun layers."

Page 133, line 29.

*Delete* "rimer."

Page 134, line 5.

*Delete* "capsquares are properly secured," and *add* "stop valve is open."\*

Page 134.

*Add* note at bottom of page:—

\* "In case of damage to the accumulator or pipe, close the stop valve."

Page 135, line 1.

*Delete* "rimes out the vent," and *insert* "looks through the vent, and if it is not clear uses the vent bit from the front."

Page 135, line 20.

*After* "rear hoist" *delete* comma, and *insert* full stop, then begin a new line:—"11 fixes the traversing wheel, and takes post to traverse if required."

Page 135, last paragraph.

*Delete* from "The Gun Captain" to "High enough," line 2, page 136, and *substitute*:—"The Gun Captain now gives the order 'Raise,' and when the shell is high enough gives the order 'High Enough'; 2 places the lever to 'Raise,' bringing it back to the centre just before the shell is high enough, then again moves it slowly toward 'Raise,' bringing it at once to centre on the Gun Captain's order 'High Enough.'"

Page 136, line 8.

*Delete* "places saturated sponge cloth over mushroom head, and."

Page 136, line 27.

*Place* full stop after "second," and *delete* "then removes sponge cloth, and throws it into the bucket."

Page 136, line 34.

*Delete* "with," and *insert* "against."

Page 136, Note.

*Delete* "All," and *insert* "The shell," and in the same line, *after* "wheel" *insert* "when laying by Case I or autosights."

Page 137, line 24.

*After* "electricity" *add* "asterisk," and *insert* note at bottom of page:—

"\* When firing by percussion the 'A' lead should be detached from the lock, as it is liable to cause a missfire."

Page 138, line 11.

*Delete* from "The Gun Captain" to "as detailed above," line 25, and *substitute*:—"The Gun Captain gives 'Stand Clear,' and sees that no one is in a position where he might be struck by the tube if it should be blown out by a hangfire; then, without making any pause, No. 3 cocks the lock, hooks the lanyard to the guide bolt of 'link actuating lock,' and, keeping clear of the vent, pulls to the rear and to the right, when the lock will travel to the right and eject the tube. No. 2 or the nearest number picks up the tube and shows it to the Gun Captain, who sees whether it is fired or not.

If the tube has fired the breech will be opened after a pause of 3 minutes, and the charge re-adjusted if necessary.

If the tube has not fired, the Gun Captain orders No. 2 to insert a new tube. No. 2 will insert a new tube. (In the case of electric firing the spring must be eased by Nos. 2 and 3 before the tube is inserted.) No. 2 will then push the lock to the left, and, when all are clear of the recoil, will give the word 'A 1 Ready.'

Should there be a second missfire, the same procedure will be carried out except that if it is again the tube which has not fired, percussion firing will be resorted to; and in the case of a second missfire at percussion firing, the lock will be changed."

# **Amendment to Handbook of the 9·2-inch B.L. Guns, Marks IX, X, and X<sup>v</sup>, 1906.**

---

Pages 95, 107, and 113, Range Tables for 9·2-inch B.L., Marks IX and X guns (Composite full charges), "Muzzle velocity 2,643 f.s." should read "2,700 f.s."

(Wt. 5680 4000 6 | 07-II & S 1690)

# AMENDMENTS TO HANDBOOK

OF THE

## 9·2-inch B.L. Guns, Marks IX, X, and Xv.

(LAND SERVICE), 1906.

Page 3.—After line 13, insert—

"Position of centre of gravity (without breech mechanism)"	157·6-inches from face of breech	164·5-inches from face of breech."
--	----------------------------------	------------------------------------

Line 14, after "weight" insert "nominal."

After line 14, insert—

"Weight of gun without breech mechanism"	26-ton 8-cwt. 1-qrs.	27-ton 19-cwt. 0-qrs."
--	----------------------	------------------------

Page 23.—Insert the following two tables:—

### PARTICULARS OF B.L. 9·2-INCH MARK III BARBETTE MOUNTING FOR LIFTING PURPOSES.

#### Weight and Centre of Gravity of Main Portions.

Name of main portions.	Average weight.	Vocab. No. of Lifting eyes where provided for.	Number of Lifting eyes used.	Centre of Gravity.	Remarks.
Carriage—	tons. cwt.				
block, trunnion, with hydraulic buffer,					
left....	0 19½	—	—	11 inches in rear of centre line of trunnion	
right	0 18½	—	—	10½ inches in rear of centre line of trunnion	
arm, loading	0 6½	—	—	—	
plate, clip, front....	0 11½	1	1	—	
slide	6 2	—	—	11 ⅞ inches in rear of pivot centre of upper roller path	
roller ring	1 4	—	—	—	
Shield	4 9½	—	—	42 inches from front edge of shield	
Pedestal, carriage, No. 4, in halves with 2 joint plates, with bolts. each half	9 2½	—	—	—	
Racer, with traversing rack	3 0½	—	—	—	
Holdfast, carriage pedestal, No. 4A	4 12	—	—	—	

(Wt. 7585 4500 6 | 07—H & S 1195)  $\frac{P. 07}{177}$

PARTICULARS OF B.L. 9·2-INCH MARKS IV AND V BARBETTE MOUNTINGS FOR LIFTING PURPOSES.

*Weight and Centre of Gravity of Main Portions.*

Name of main portions.	Mark IV.	Mark V.	Vocab. No. of Lifting eyes where provided for.	Number of Lifting eyes used.	Centre of Gravity.	Remarks.
	Average weight.	Average weight.				
	tons. cwt.	tons. cwt.				
Bands, { connecting, gun and buffer, in 2 parts, { with cap and screws	—	1 8½	3	1	—	
{ gun, rear	—	0 15½	3	1	—	
Bars, sliding gun (2)      each	—	0 12½	1	2	—	
Carriage body, including—						
capsquares, cradle with air cylinder, hydraulic buffer, 2 elevating arcs, 2 sliding blocks, and band connecting gun and buffer	26 3	—	—	—	4 inches in rear of centre line of trunnion	
capsquares, brackets, cross shaft, shaft arc pinion with 2 pinions, friction rings, worm wheel and guard	—	13 8	—	—	34 inches in rear of centre line of trunnion	
Cradle, including—						
air cylinder, hydraulic buffer, and 4 caps securing compressors	—	9 8	—	—	31 inches in rear of centre line of trunnion	
Shield, front (without stays)—						
left portion (with butt plate)	—	7 15	2	2	—	
right portion	—	7 6½	2	2	—	
Shields, side (2)      each	—	1 14½	4	2	—	





40185  
9675

**Amendment to Handbook for the 10-pr.  
Jointed B.L. Gun (Mule Equipment),  
1902.**

PUBLIC LIBRARY OF VICTORIA

---

*Delete* :—Diagram facing page 35.

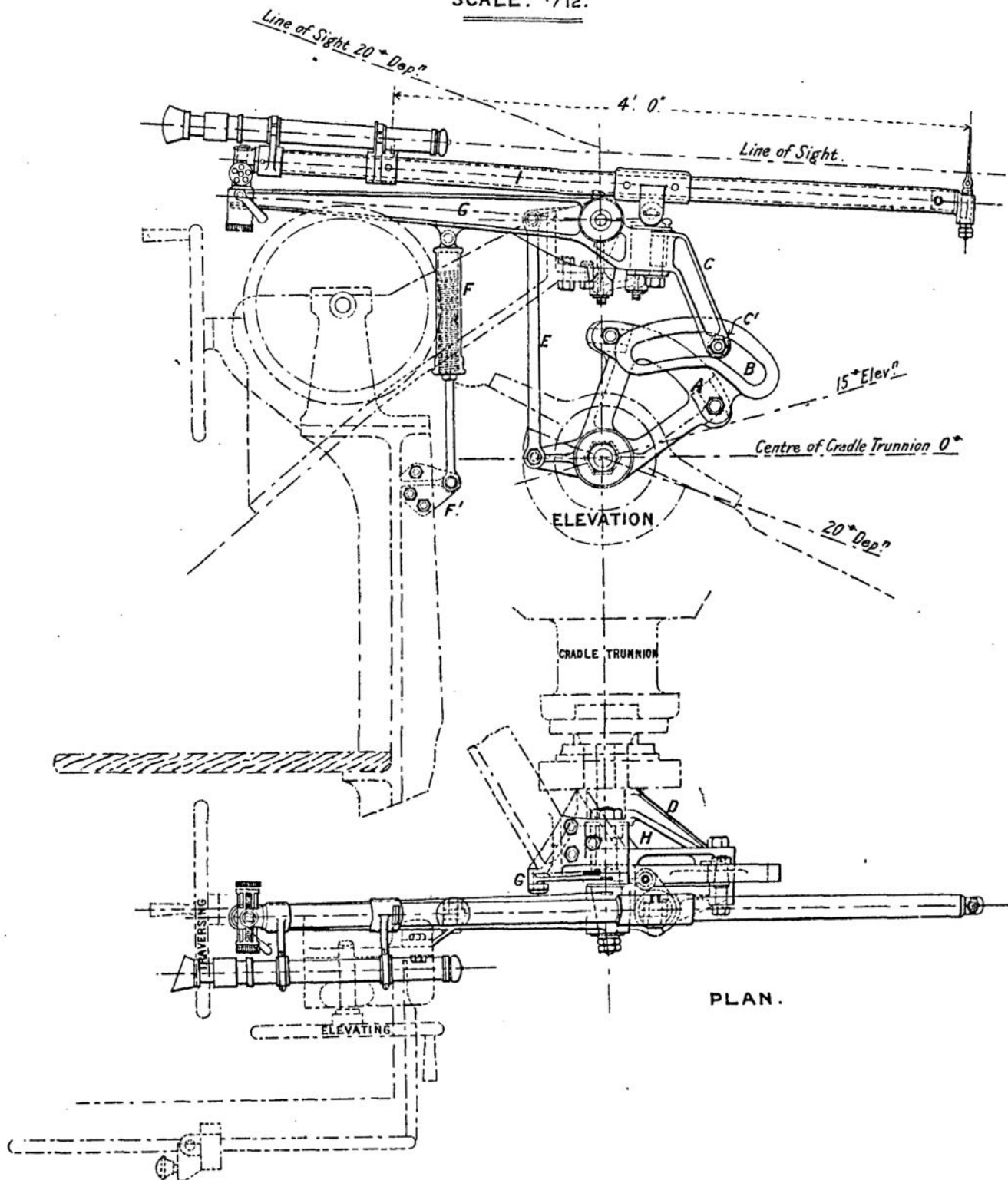
*Insert* :—

NOTE.—The diagram on page 287, Mountain Artillery Drill (India), 1897, shows the correct position of a Battery drawn up for Inspection, the 10-pr. B.L. Gun being substituted for the 2·5-inch R.M.L. Gun.

# CARRIAGE, GARRISON, BARBETTE, B. L. 9.2 INCH, MARK IV.

## GENERAL ARRANGEMENT OF AUTOMATIC SIGHTS, RIGHT SIDE.

SCALE.  $\frac{1}{12}$ .

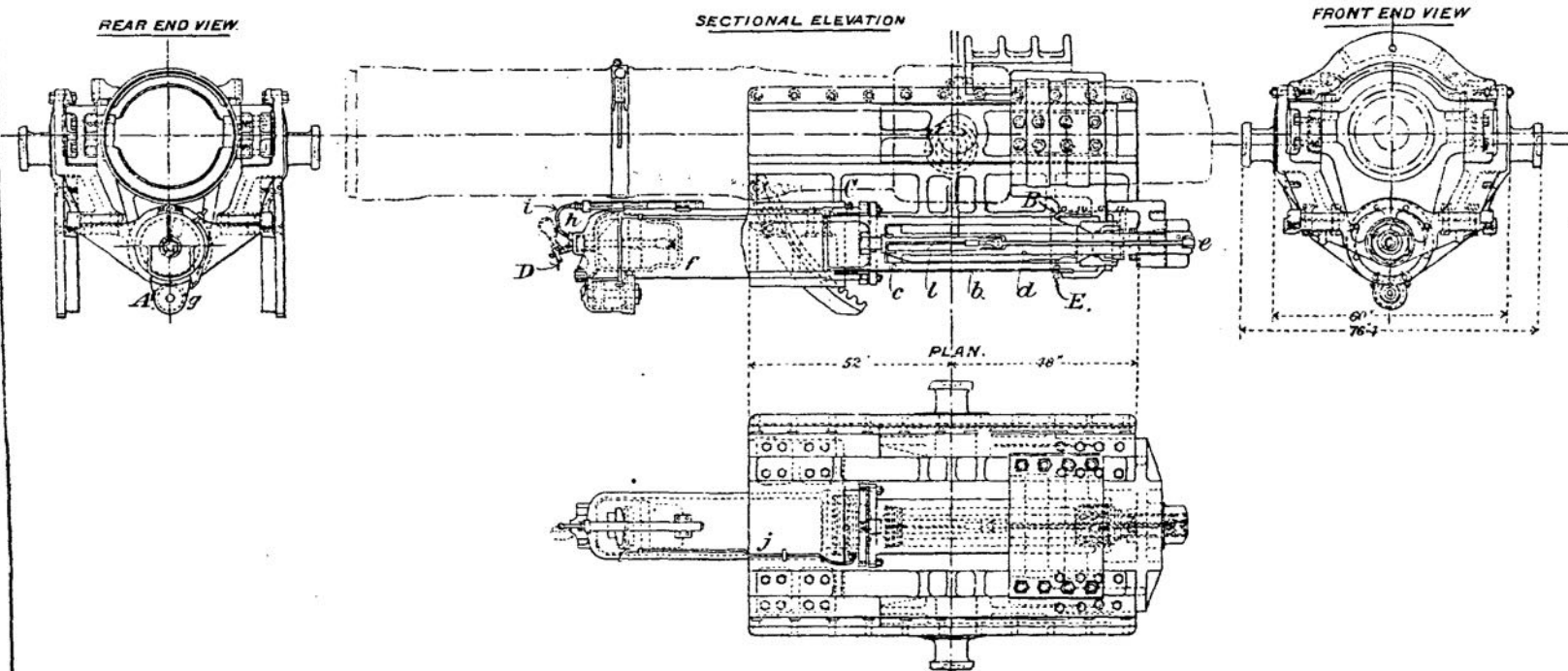


3433-05.

# CARRIAGE, GARRISON, BARBETTE B.L. 9.2 INCH ( MARK IV)

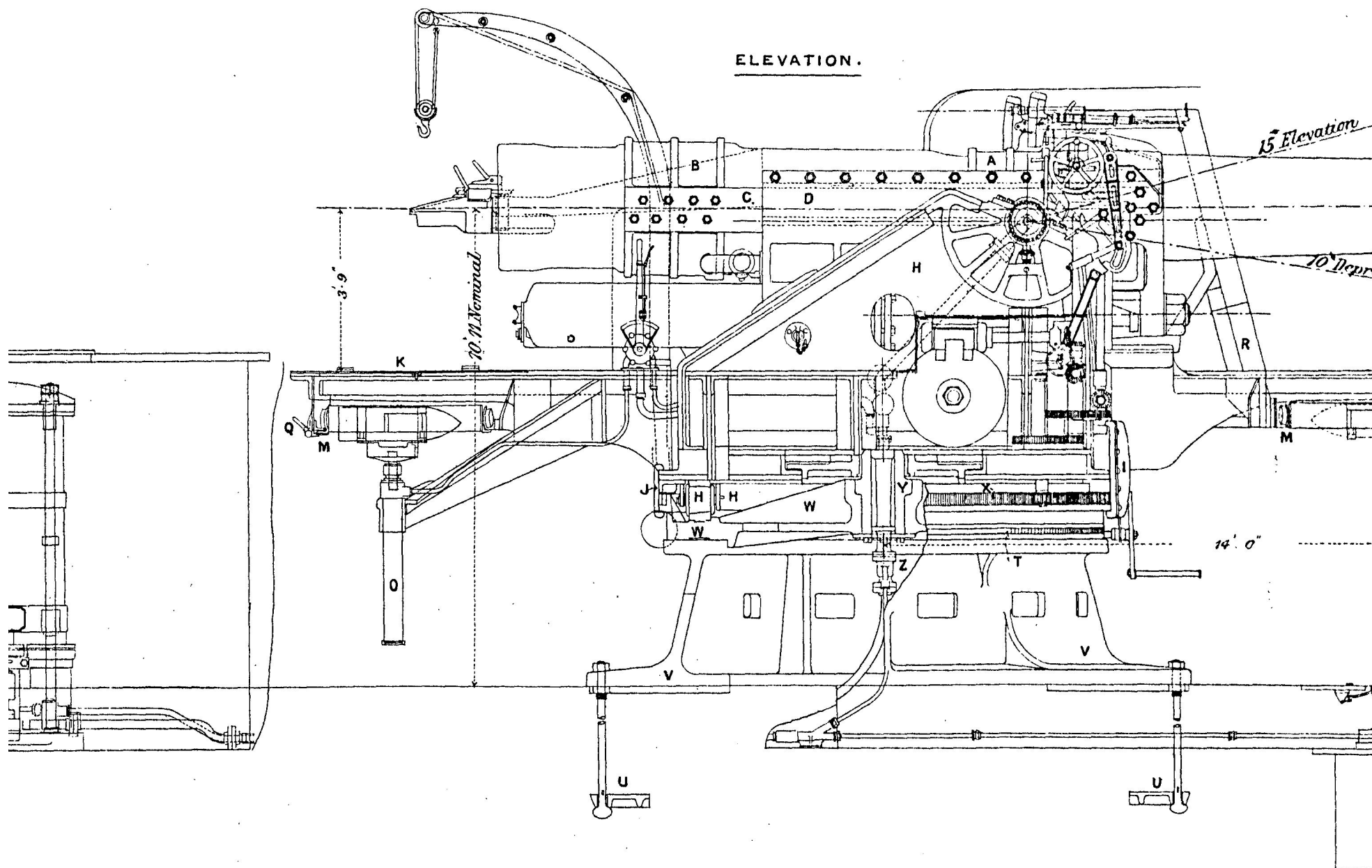
*General arrangement of Cradle with Air Cylinder and Hydraulic Buffer*

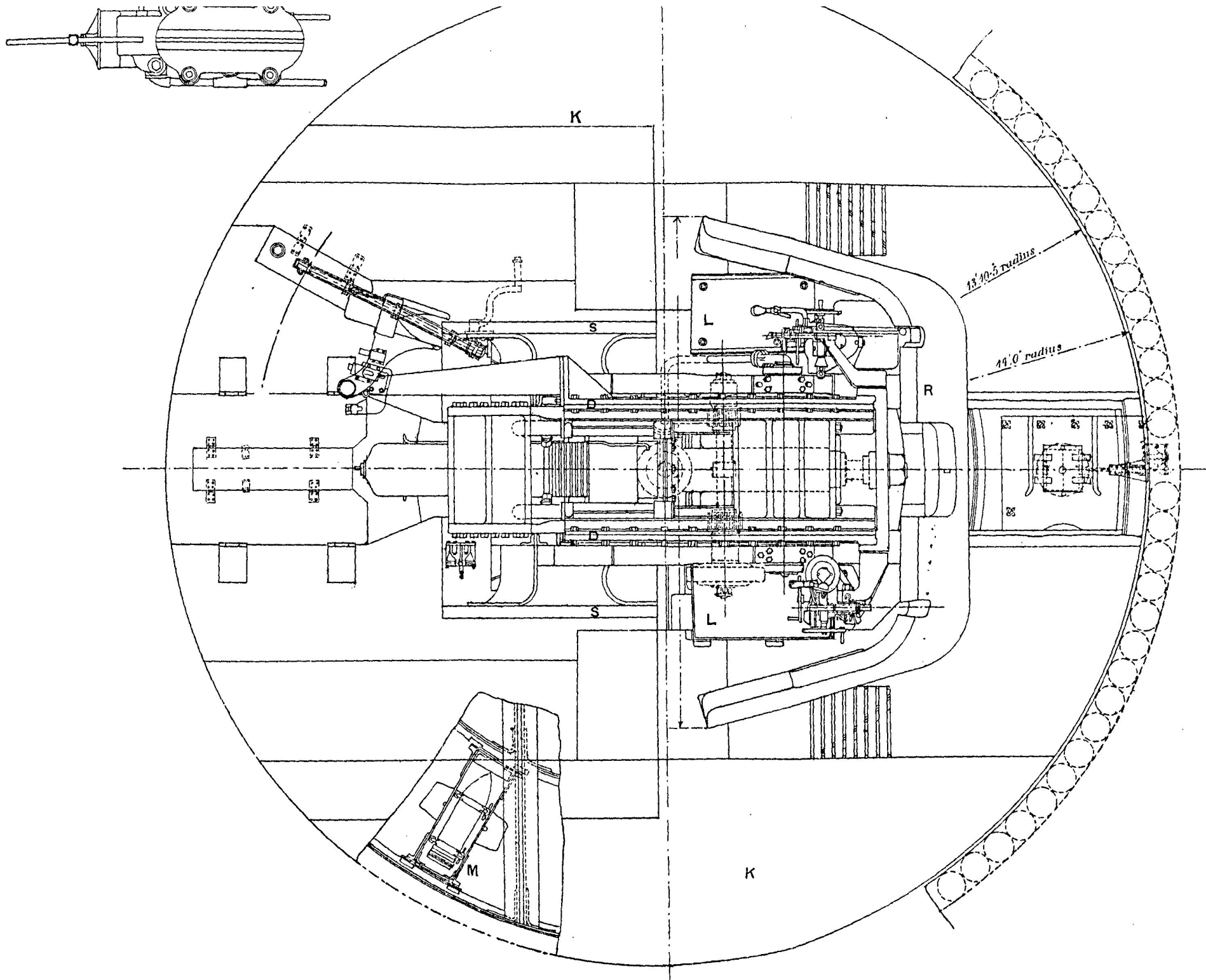
SCALE  $\frac{1}{48}$



CARRIAGE, GARRISON, BARBETTE, B.L. 9.2 INCH, (MARK V).L.

SCALE 1/36.



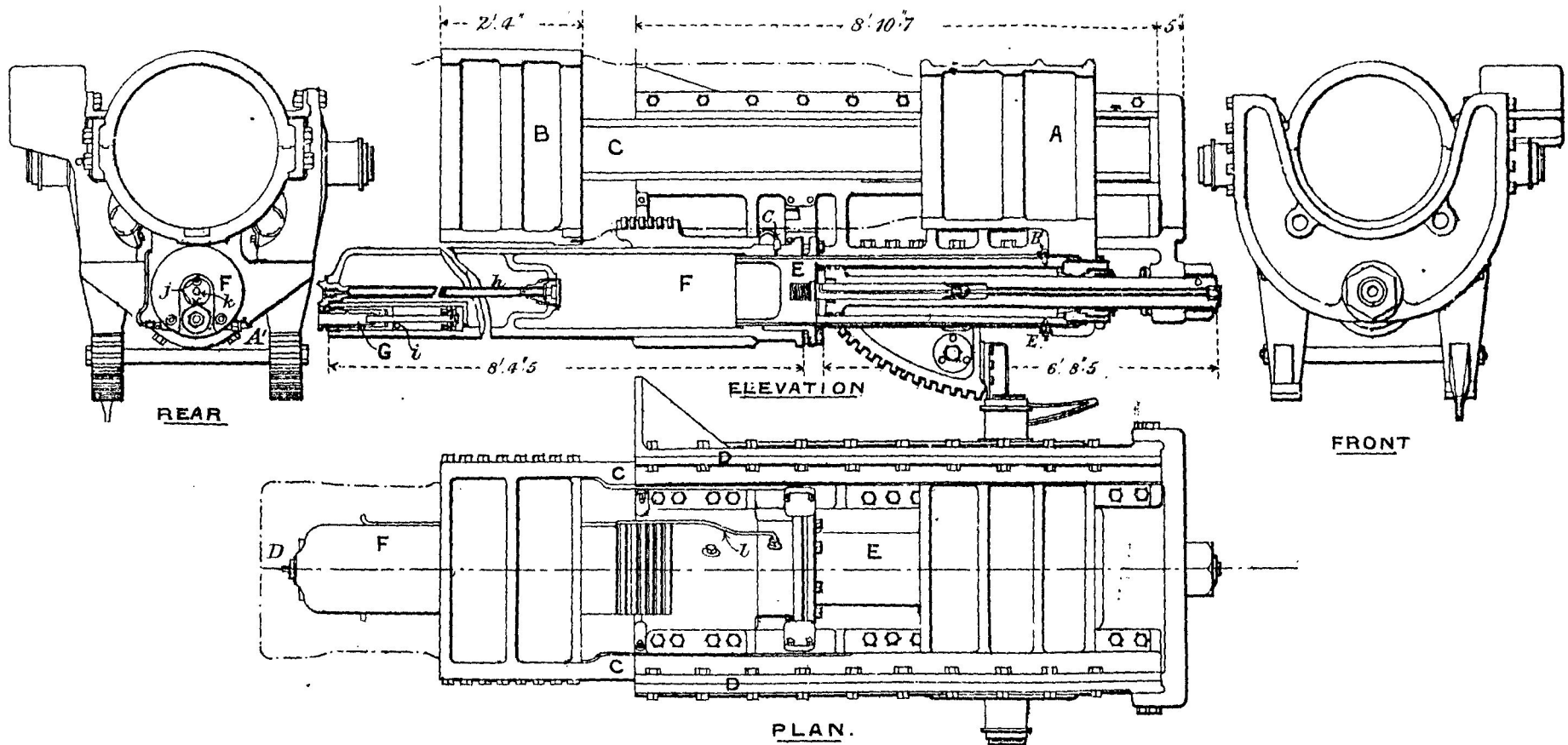


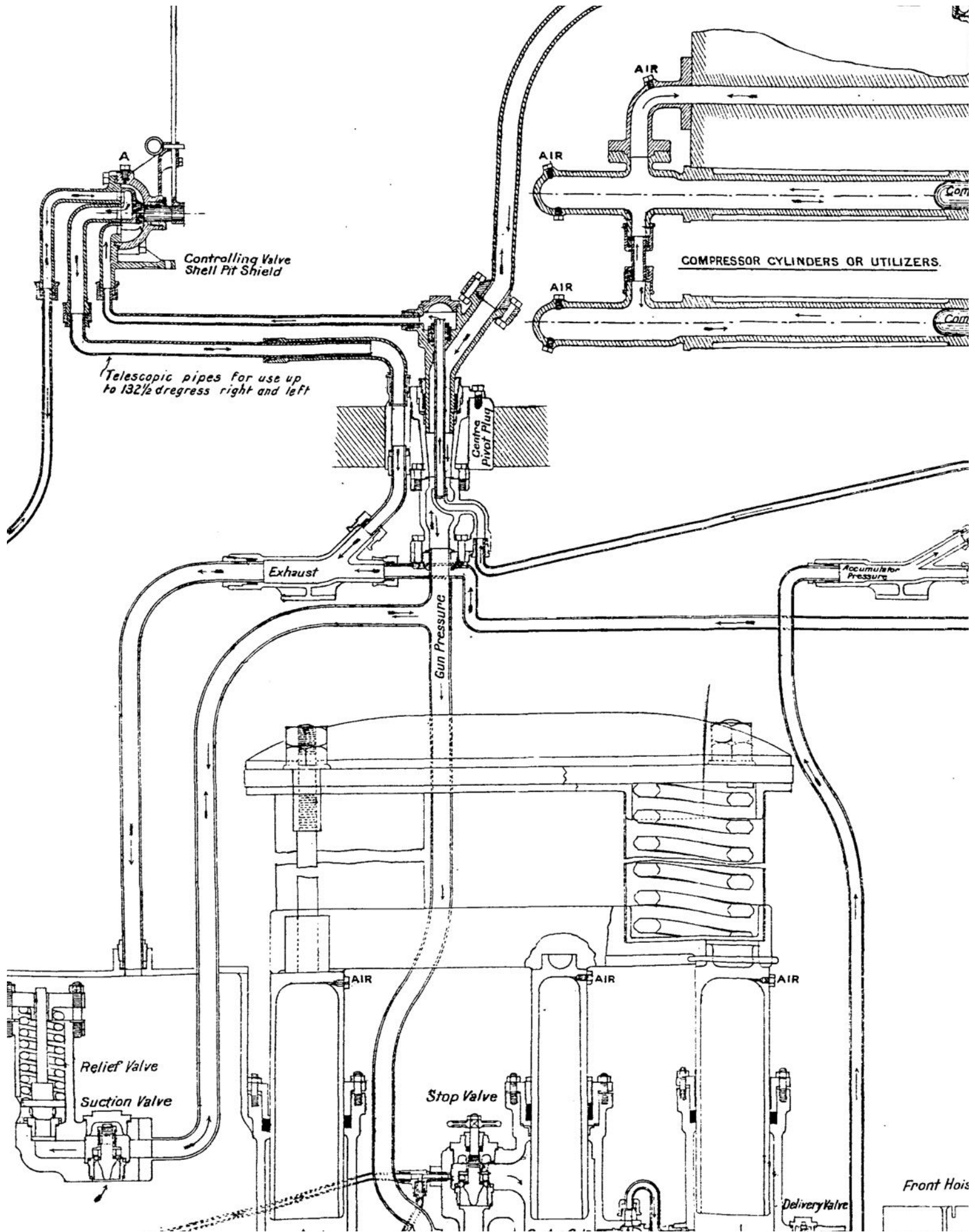
CARRIAGE, CARRISON, BARBETTE, B.L. 9-2 INCH (MARK V) L.

*Cradle.*

GENERAL ARRANGEMENT.

Scale 1/32

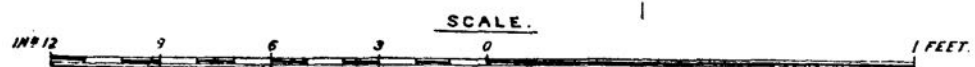
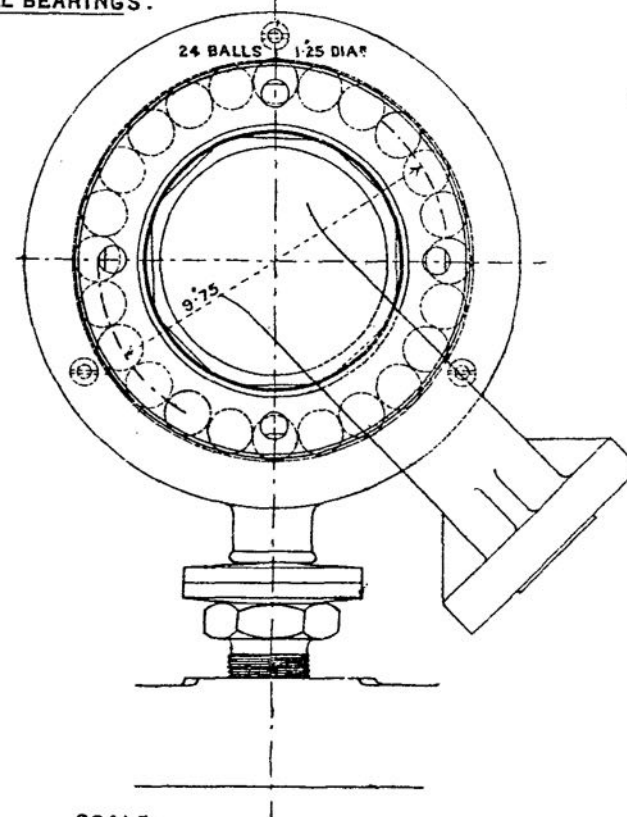
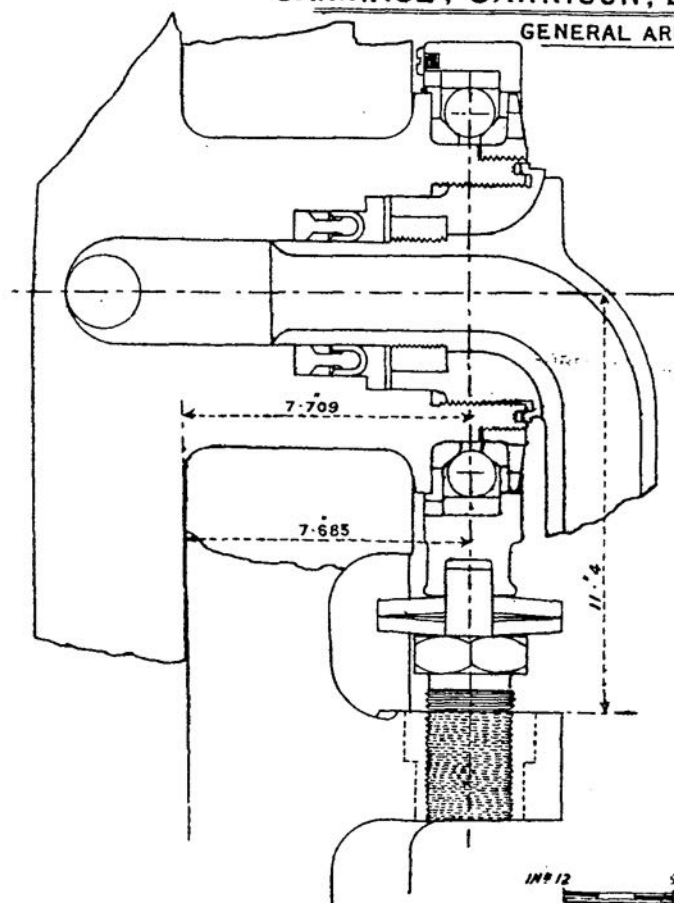






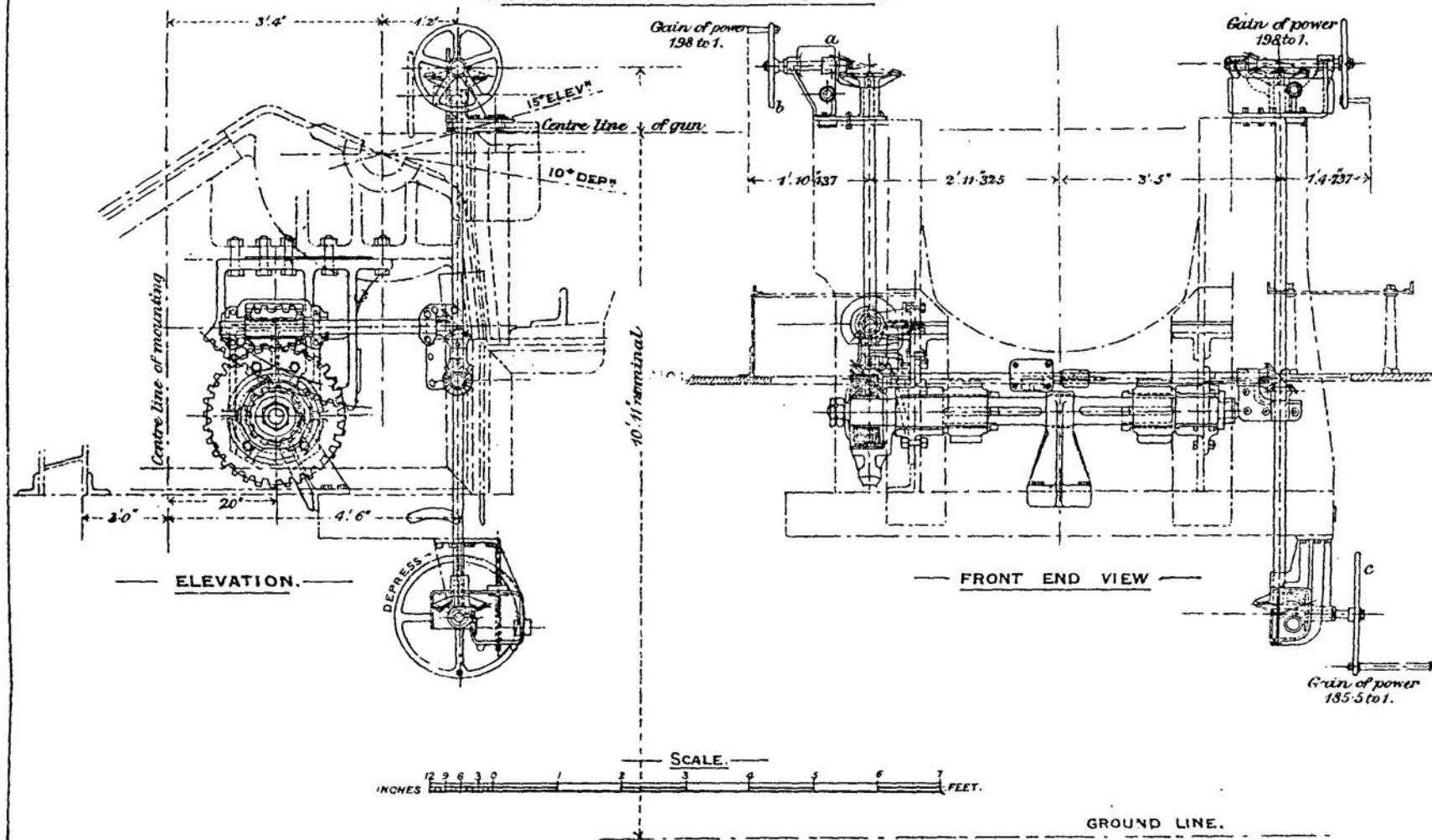
# CARRIAGE, GARRISON, BARBETTE, B. L. 9.2 INCH, (MARK V.) L.

GENERAL ARRANGEMENT OF BALL BEARINGS.

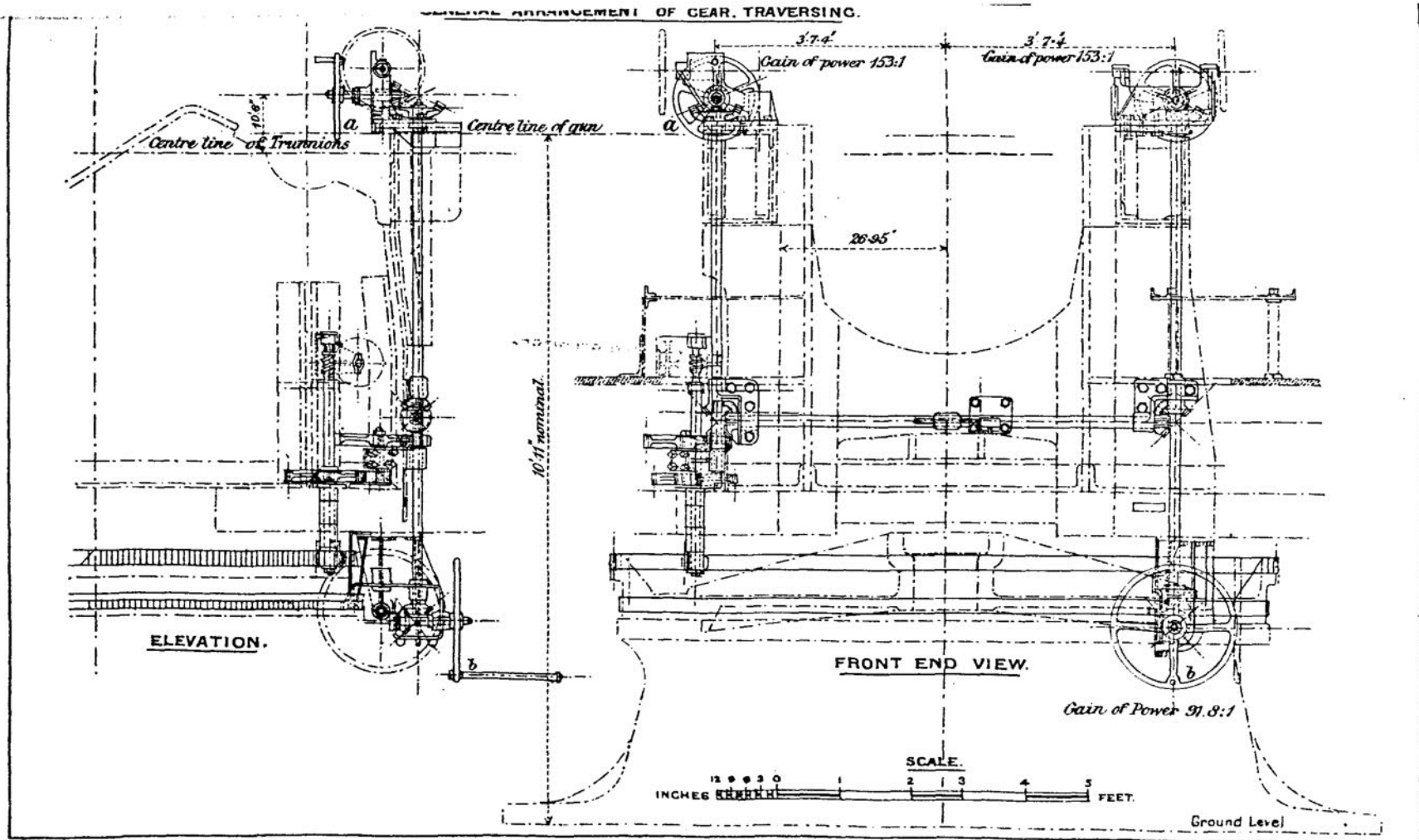


# CARRIAGE, GARRISON, BARBETTE, B.L., 9.2 INCH. (MARK V) L.

GENERAL ARRANGEMENT OF GEAR ELEVATING.



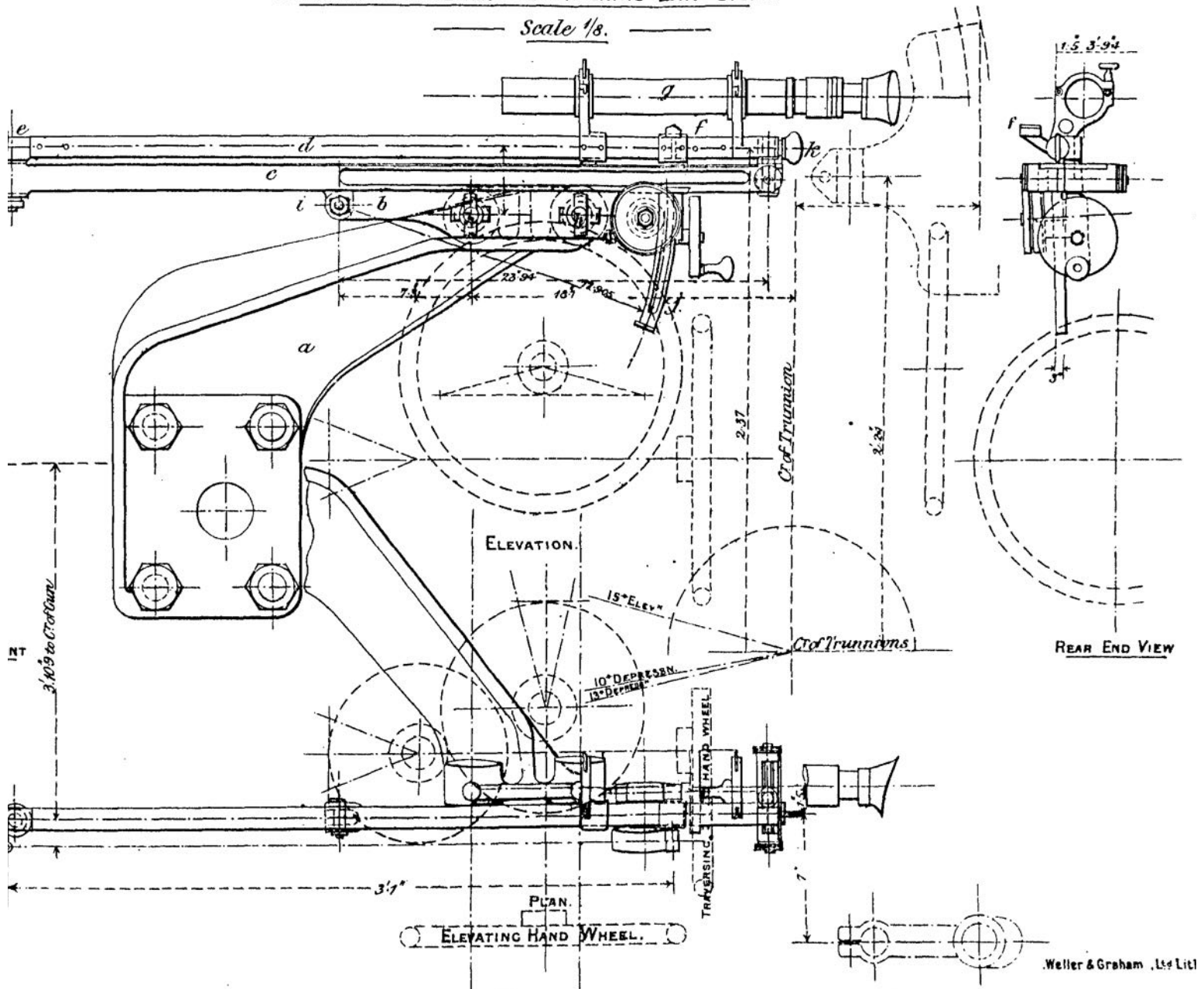
# GENERAL ARRANGEMENT OF GEAR TRAVERSING.



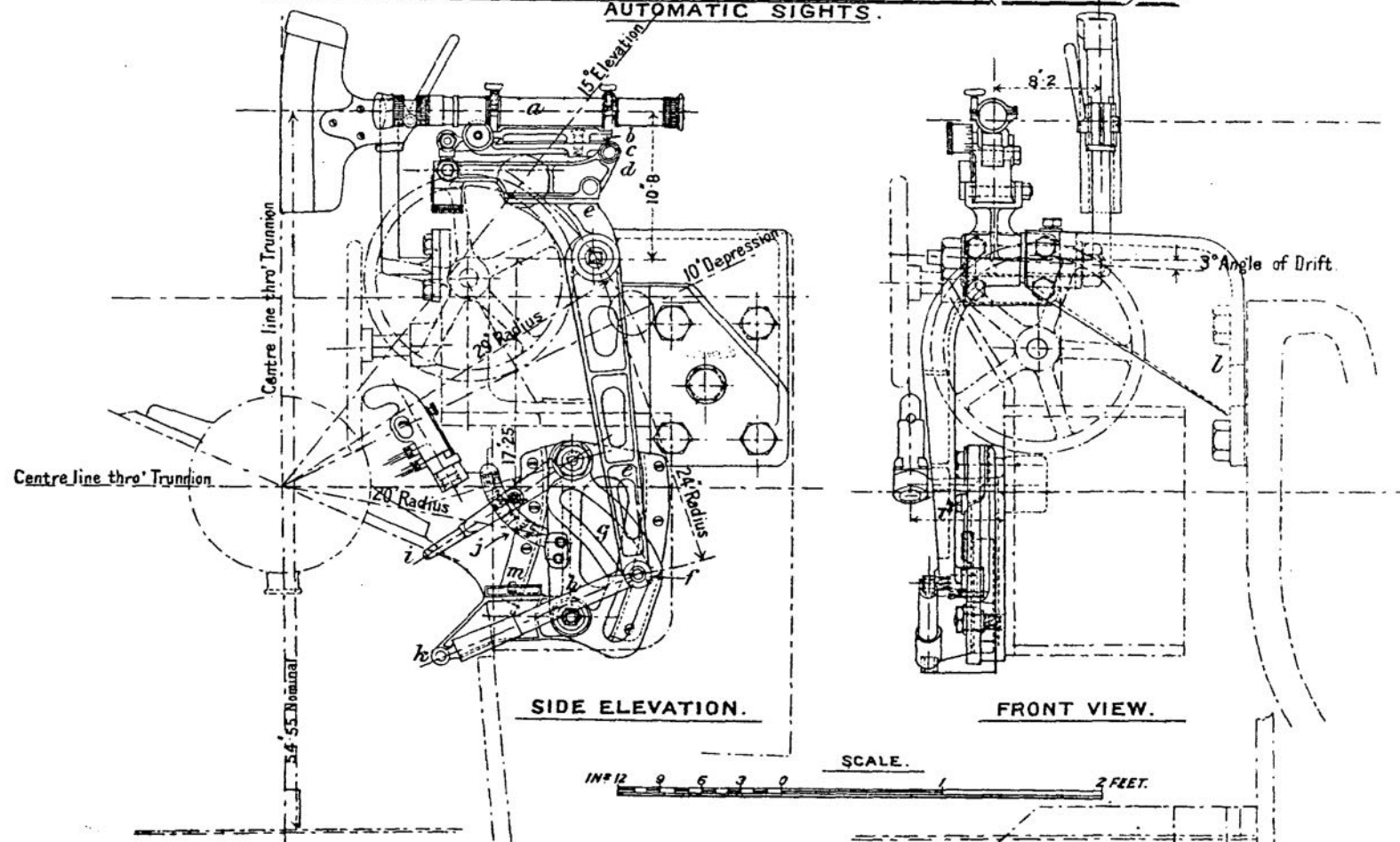
CARRIAGE, CARRISON, BARBETTE, B.L. 9-2 INCH, MARK V. L.

### GENERAL ARRANGEMENT OF ROCKING BAR SIGHT

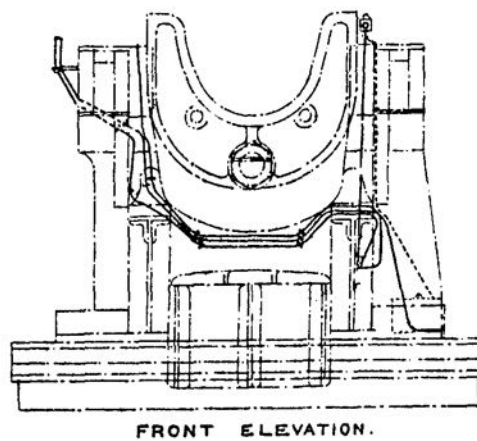
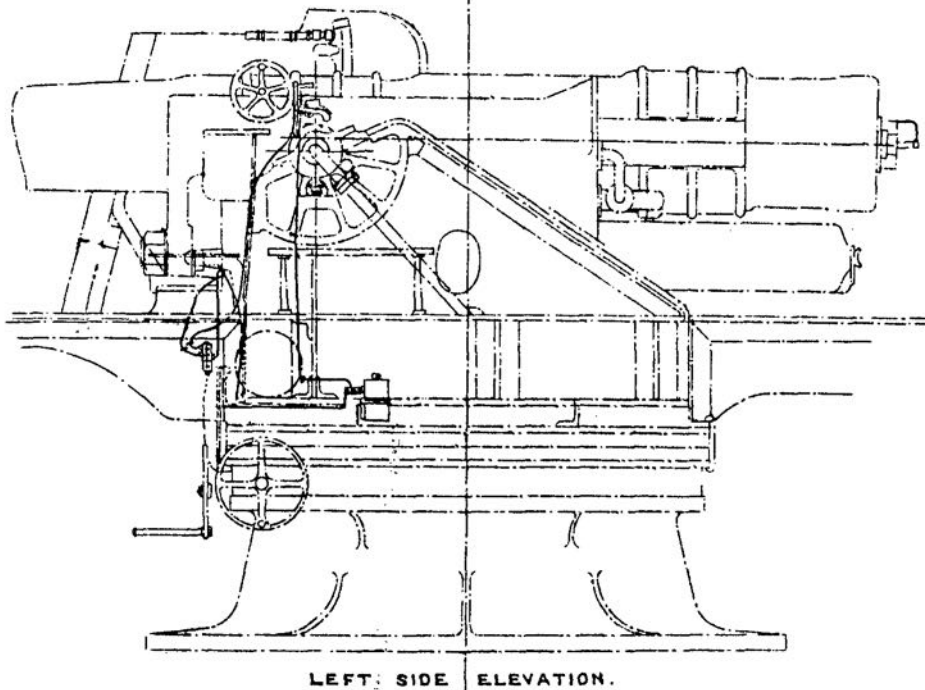
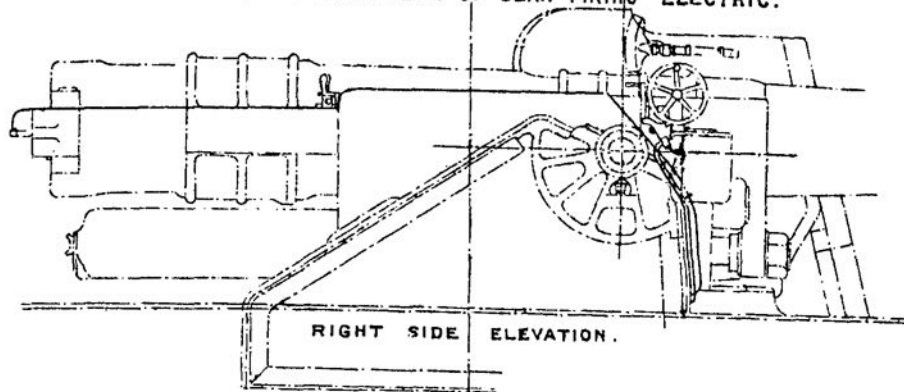
Scale 1/8.



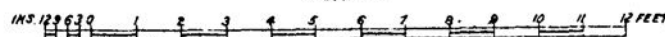
**CARRIAGE, GARRISON, DARBETTE, B.L. 9 1/2 INCH, (MARK V.) L.**  
**AUTOMATIC SIGHTS.**



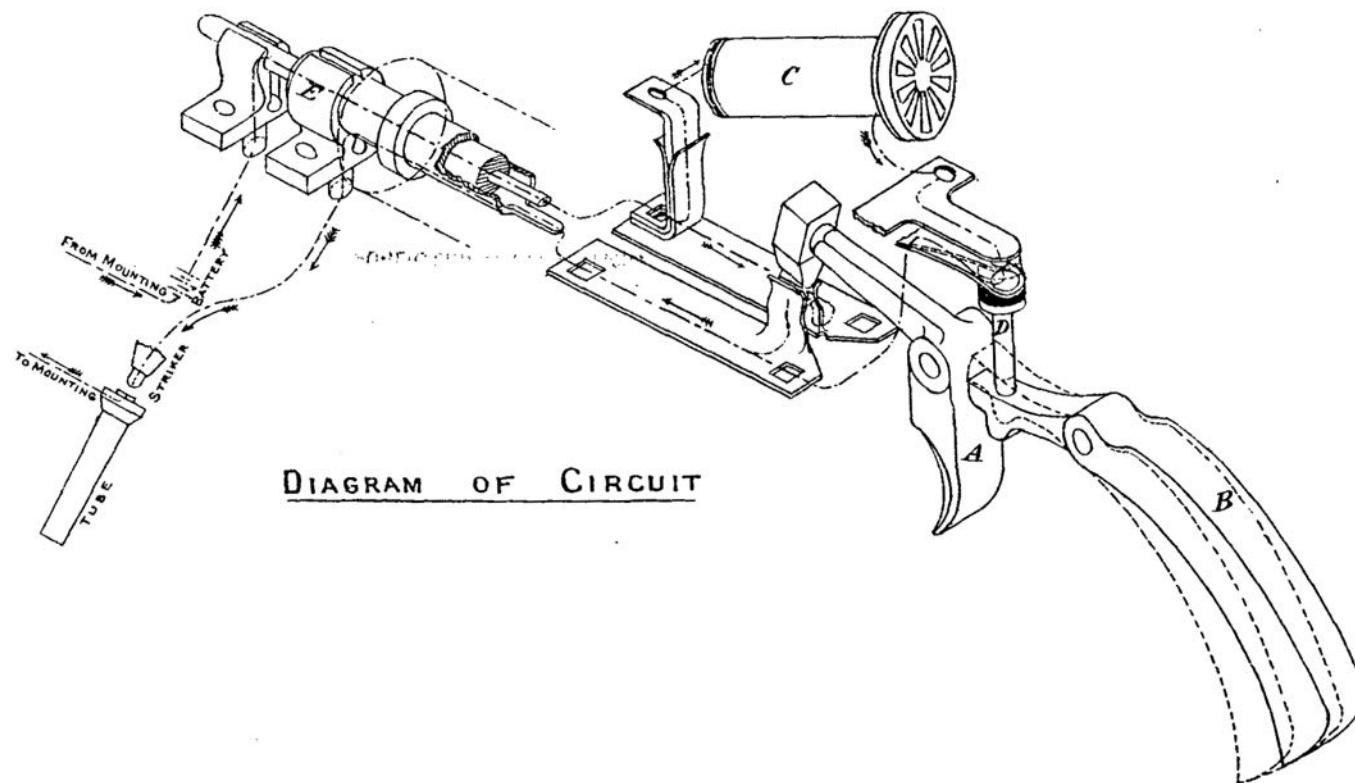
CARRIAGE, GARRISON, BARBETTE, B.L. 9.2 INCH, (MARK V.) L.  
GENERAL ARRANGEMENT OF GEAR FIRING ELECTRIC.



SCALE.



GEAR, ELECTRIC FIRING.  
PISTOL GRIP B.L. & Q.F. CARRIAGES MARK III.

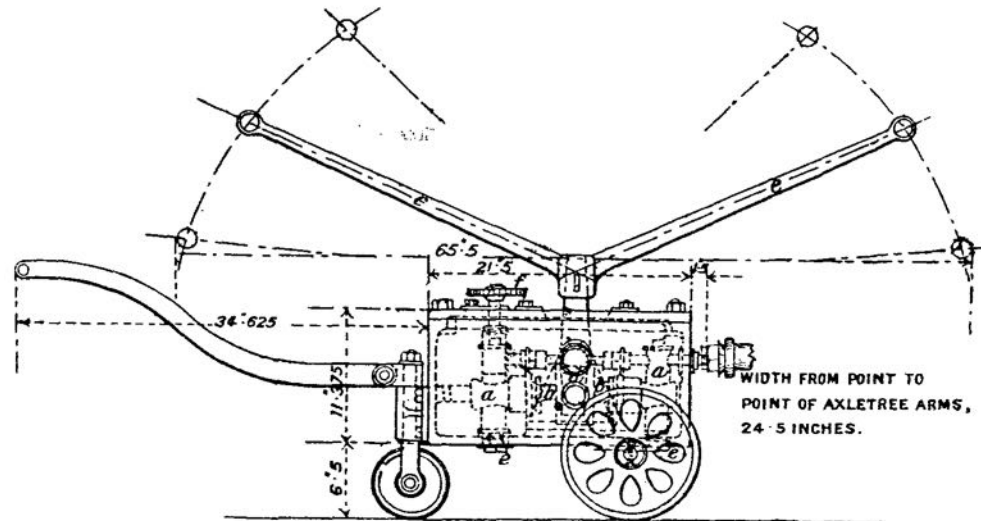


PUMP, RUNNING BACK, PORTABLE, MARK I.

CARRIAGES, GARRISON, B. L., 12-INCH, AND

9·2 INCH, MARKS III, IV, & V BARBETTE.

SCALE  $\frac{1}{16}$ .

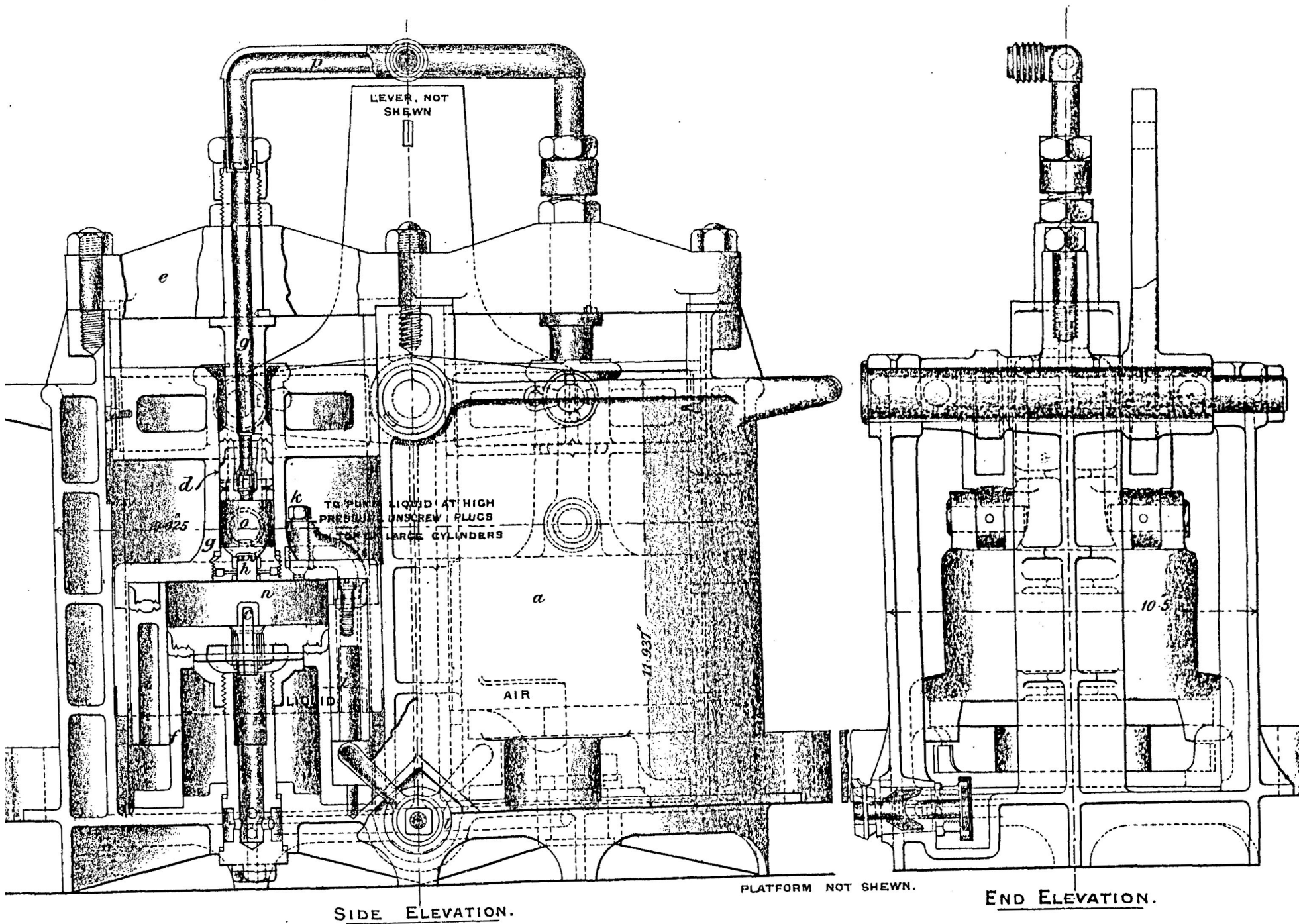


SIDE ELEVATION.

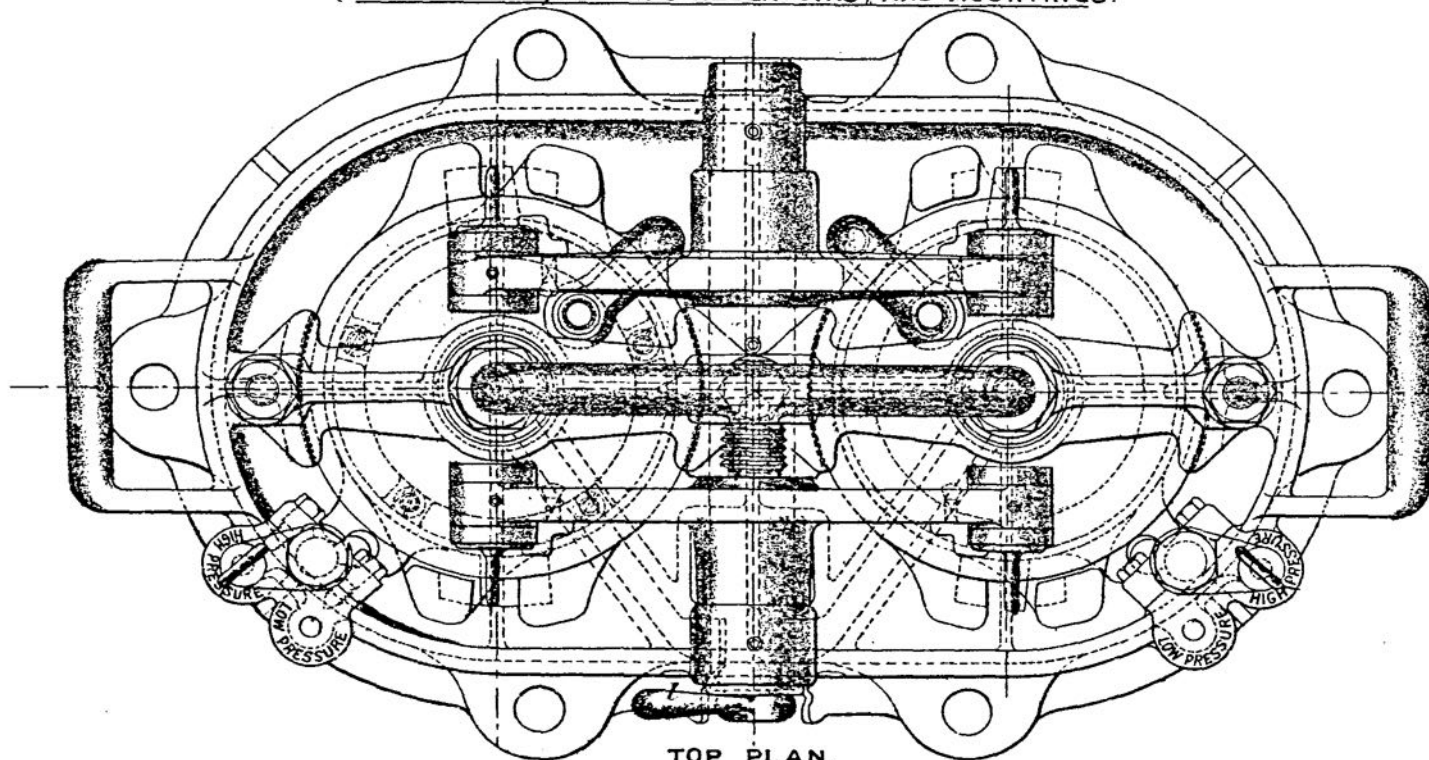


PUMP, AIR OR LIQUID, MARK 1.

WITH STAND, 4 CONNECTING PIPES, 4 ADAPTERS (1 A AND 3 B) AND 4 SPANNERS (Nº 157 TO 160;) CHARGING RESERVOIRS, & MOUNTINGS.

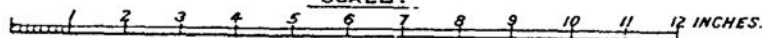


**PUMP, AIR OR LIQUID, MARK I.**  
 WITH STAND, 4 CONNECTING PIPES, 4 ADAPTERS (1 "A" AND 3 "B.") AND 4 SPANNERS.  
 (Nos 157 TO 160.) CHARGING RESERVOIRS, AND MOUNTINGS.

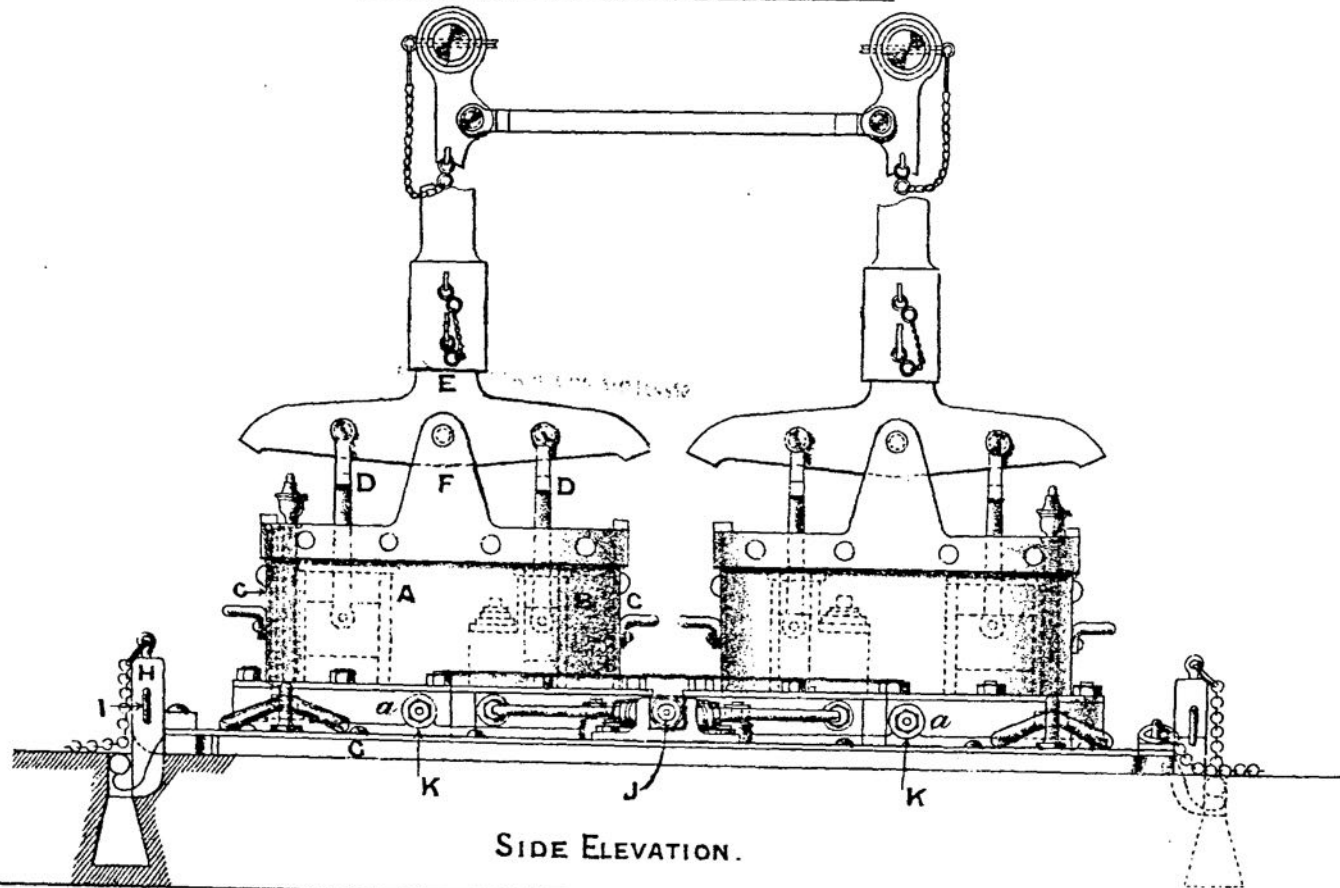


TOP PLAN.

SCALE.



# PUMP, AIR, DOUBLE, MARK I.



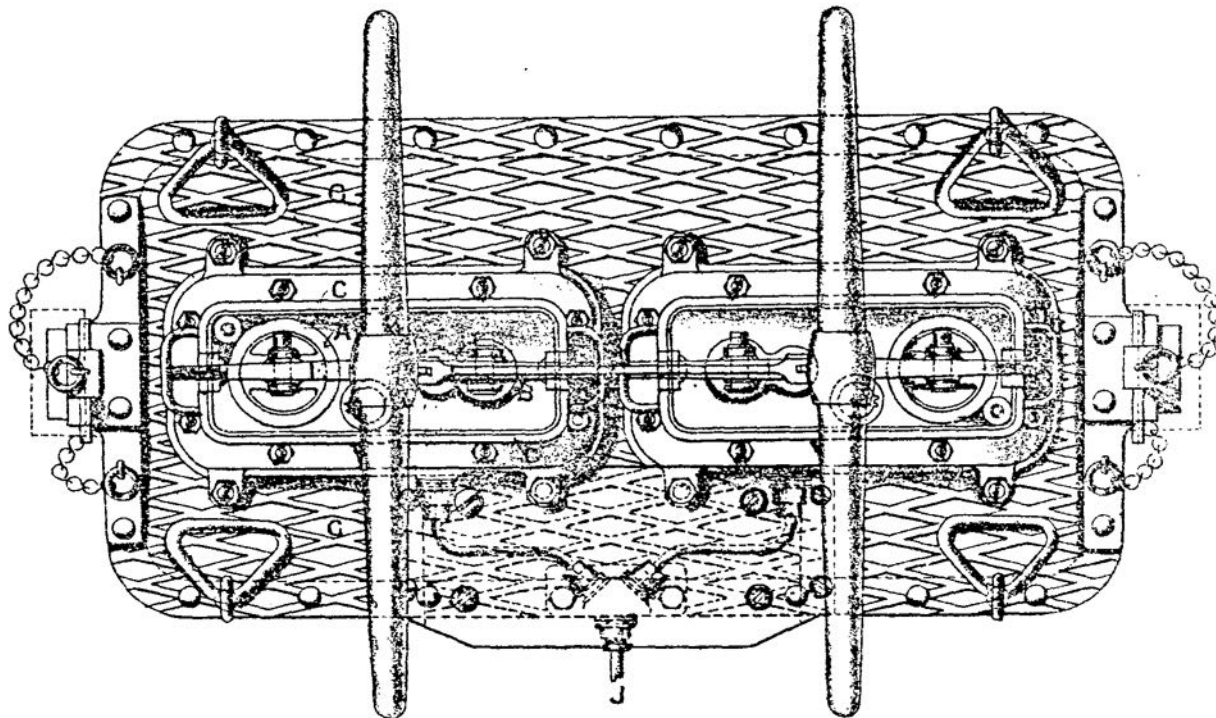
SIDE ELEVATION.

3555. 02.

Weller & Graham, Lth Litho, London.

Plate XXII.

PUMP, AIR, DOUBLE, MARK I.



TOP PLAN.

# PUMP, TESTING COMPRESSED AIR RESERVOIRS (MARK I)

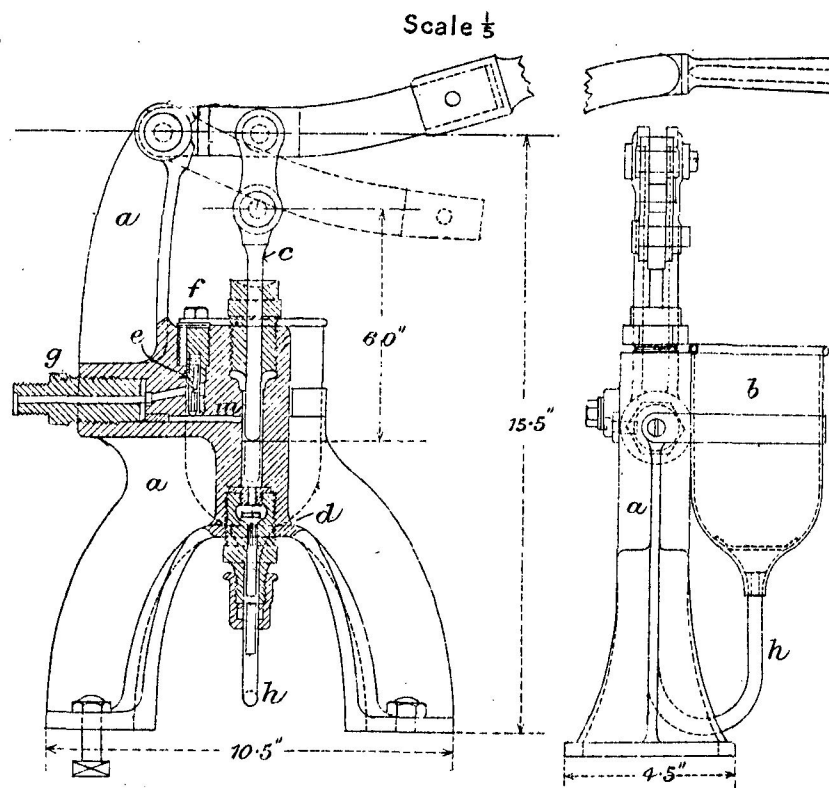


FIG. 1.

FIG. 2.

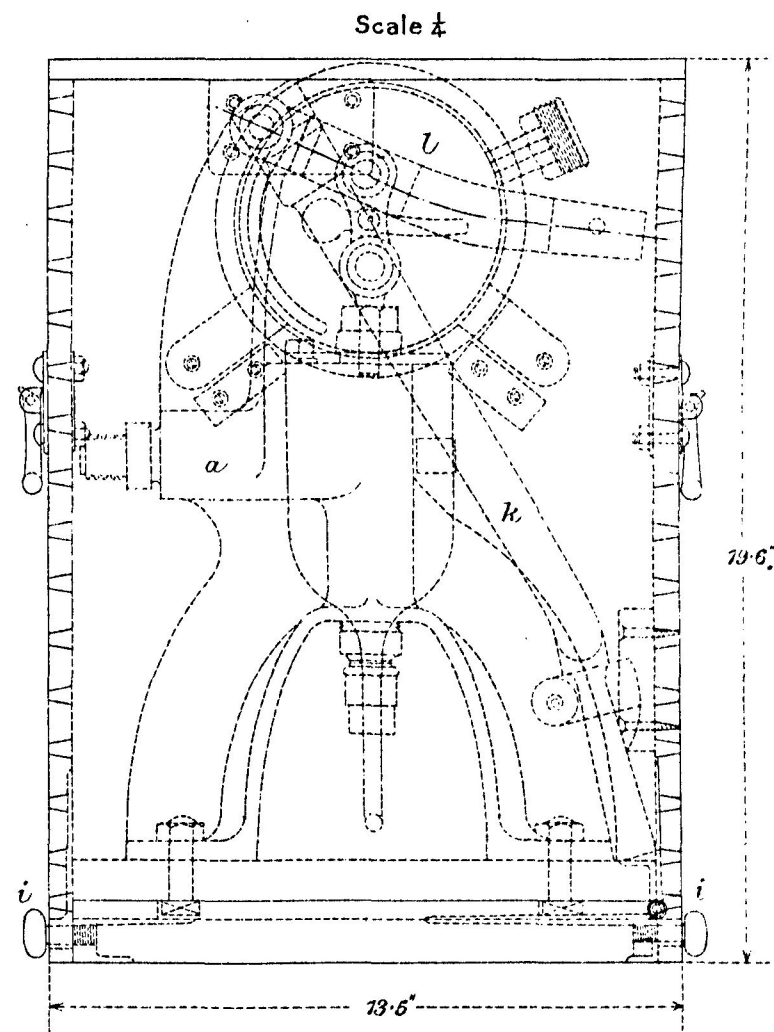
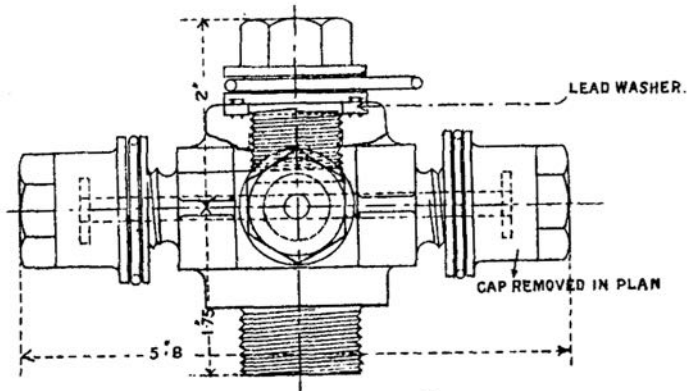


FIG. 3.

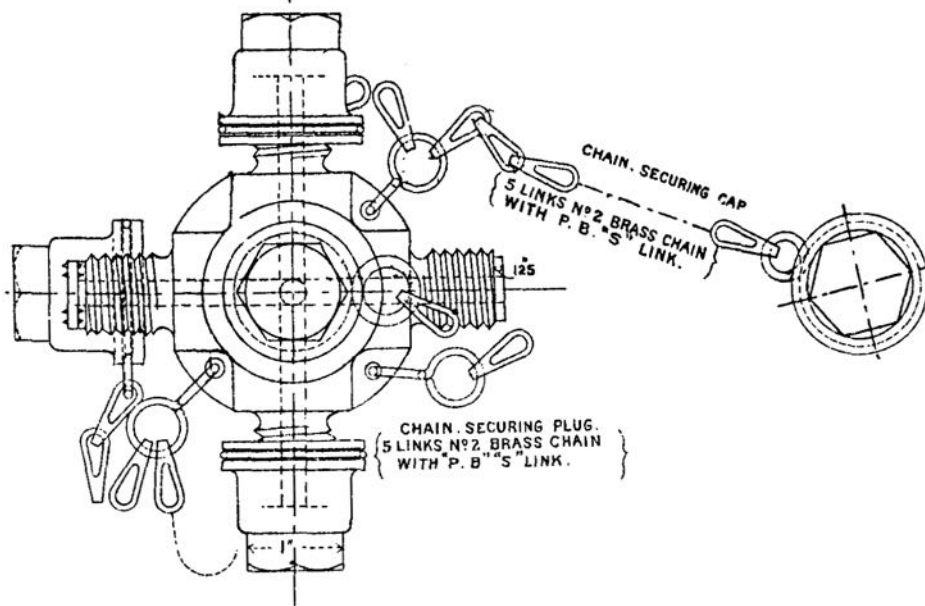
# CONNECTION, FOUR-WAY, AIR PUMP, MARK I.

HALF FULL SIZE.

## ELEVATION.

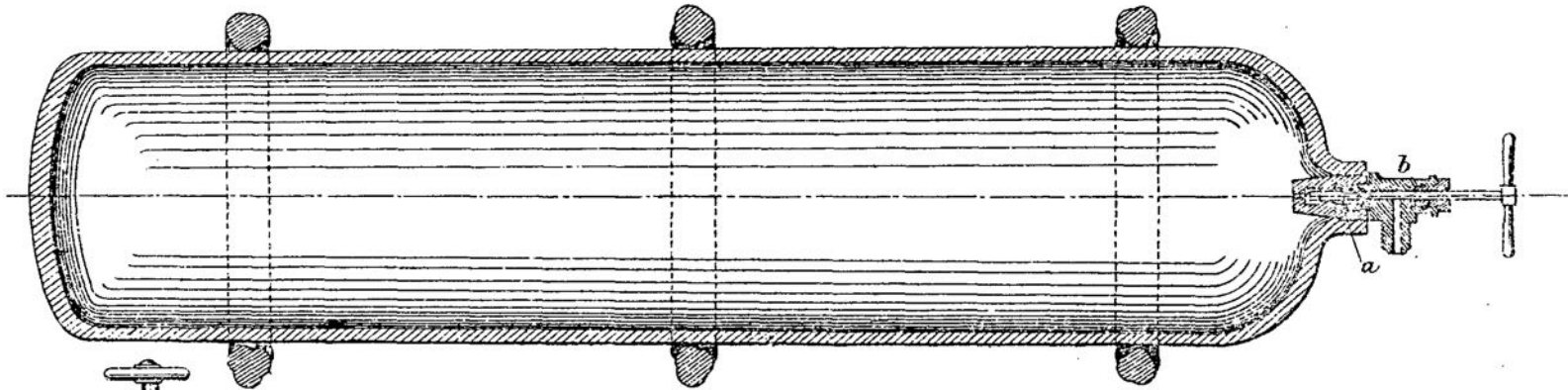


## PLAN.

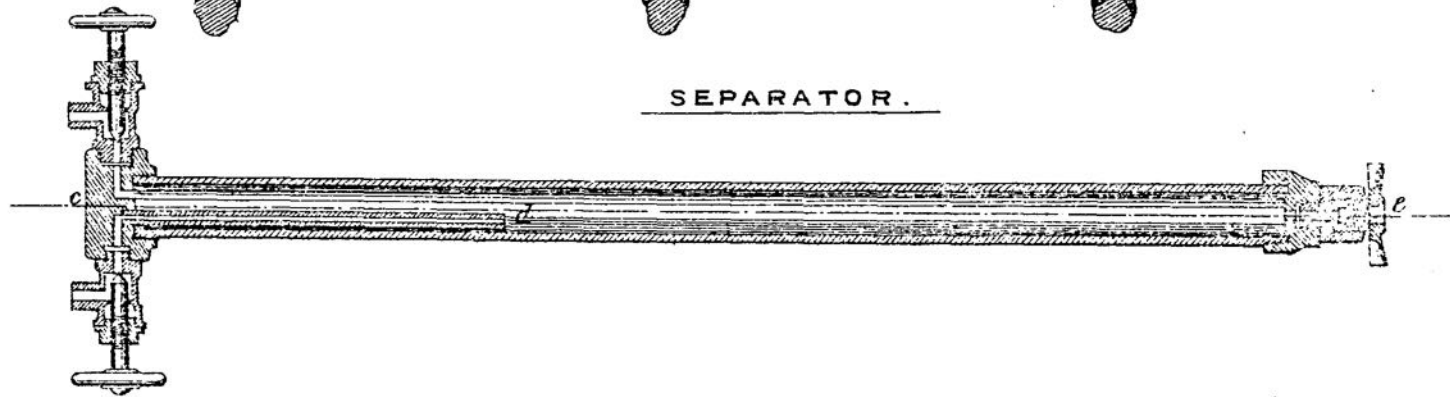


RESERVOIR FOR COMPRESSED AIR.

MARK II.



SEPARATOR.





# GAUGES, PRESSURE.

Nº 1.

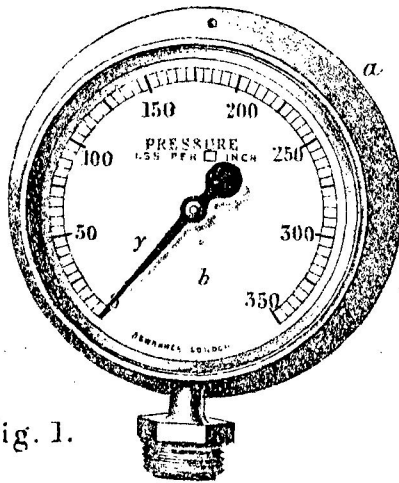


Fig. 1.

Nº 2.

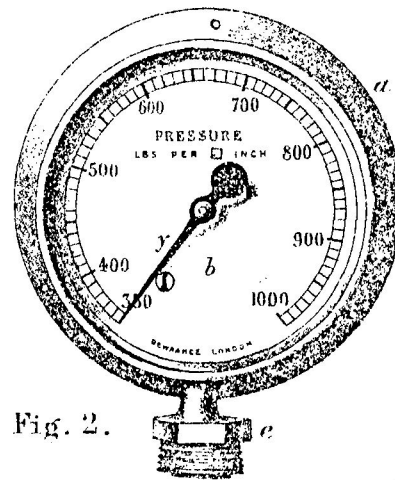


Fig. 2.

Nº 3.

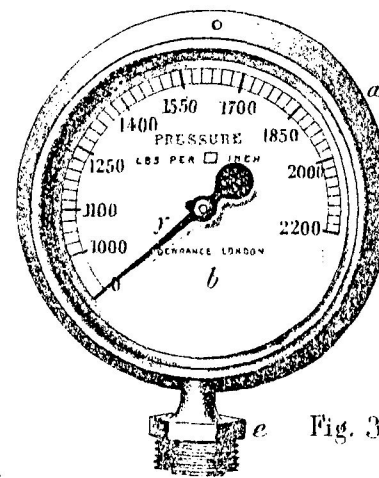


Fig. 3.

Nº 4.

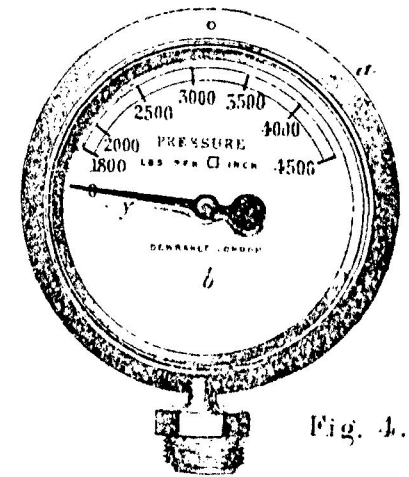


Fig. 4.

Nº 4.

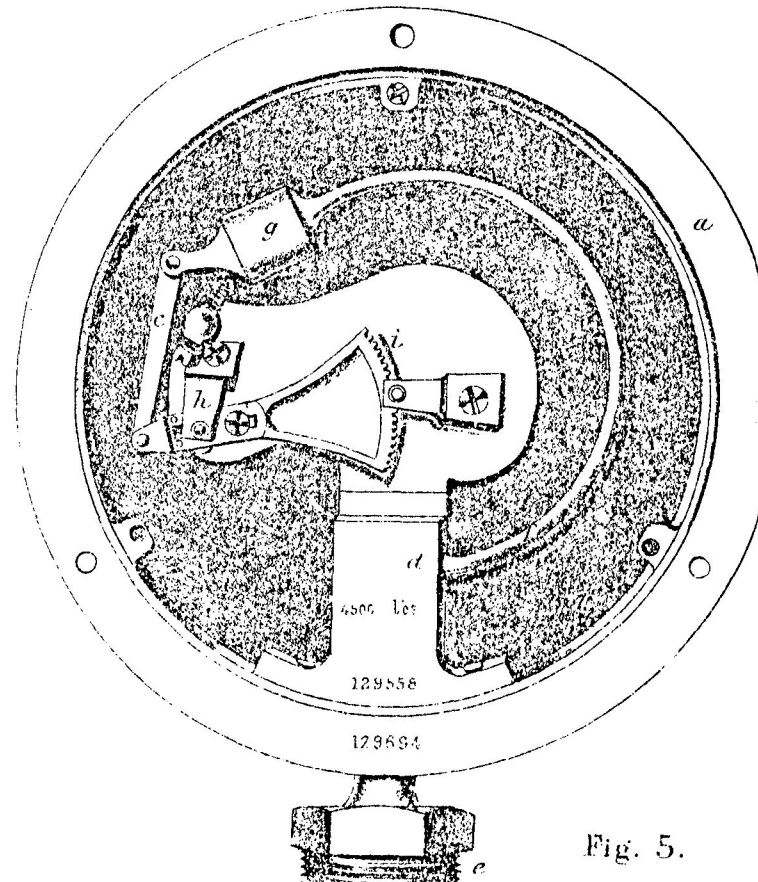
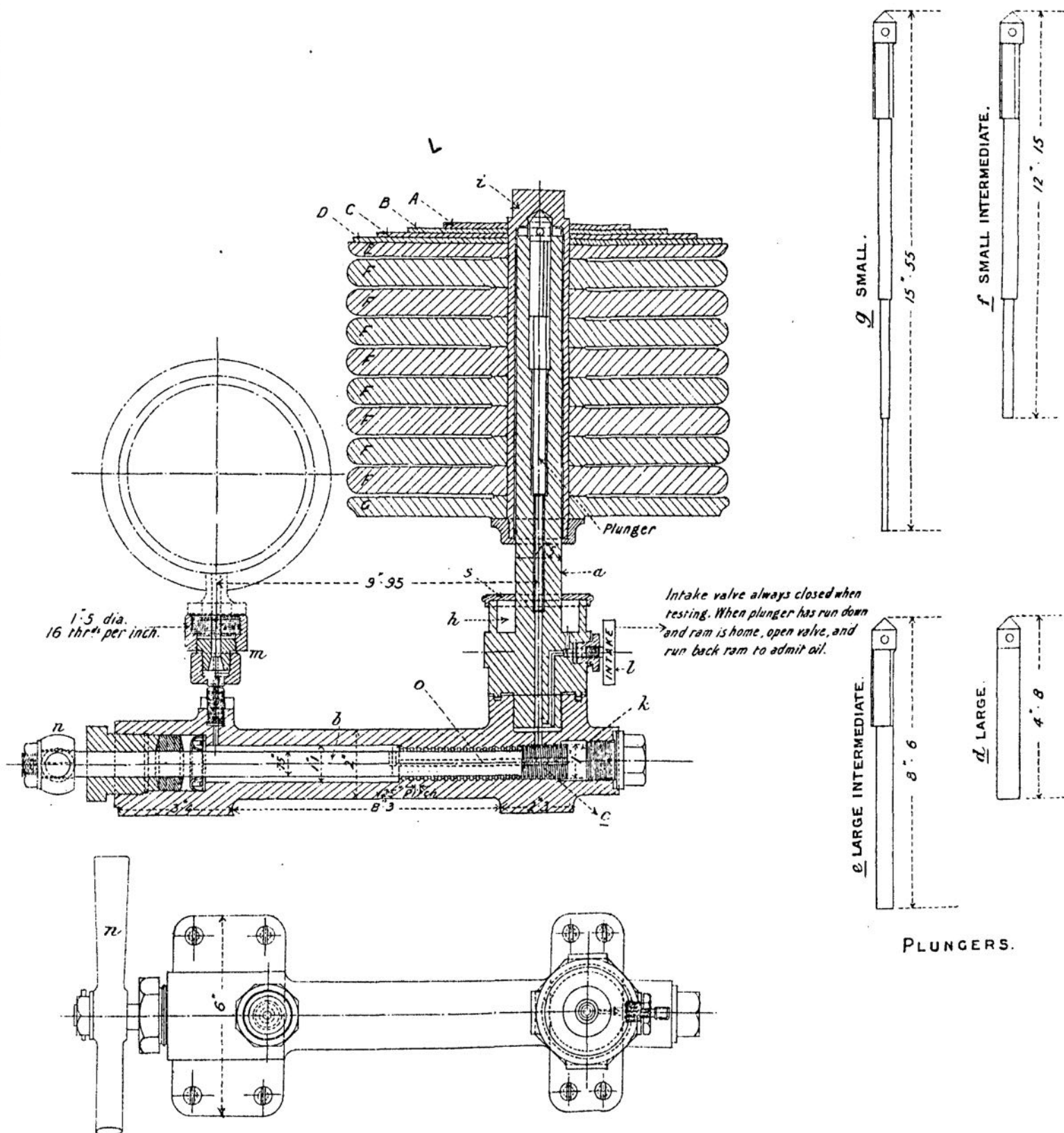


Fig. 5.



# GAUGE, PRESSURE, DEAD WEIGHT TESTING (MARK III).



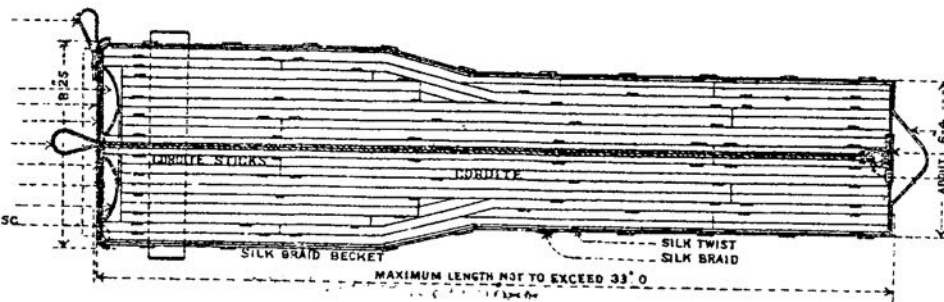
# CARTRIDGE, B. L., 9.2 INCH, 50 LB, CORDITE, SIZE 44, MARK I.

SILK CLOTH 1/2 CHARGE FOR MARK IX WIRE GUNS.

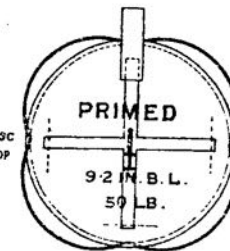
SCALE 1/8.

REC. BINDING

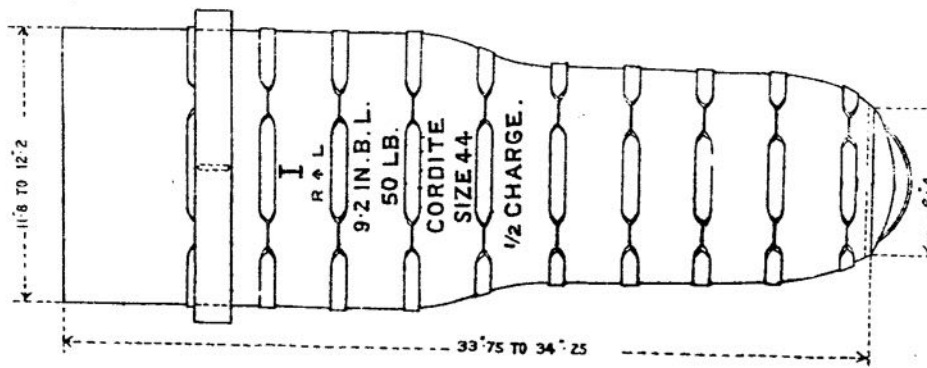
POWDER PRIMER  
SILK CLOTH ATTACHED TO  
BILLBOARD DISC.  
SILK CORD BECKET.  
SILK NETTING.  
SHALLOON DISC.  
SILK CLOTH DISC.  
SILK NETTING, SHALLOON DISC.  
& SILK CLOTH SEWN TO BAG.



SILK BRAID  
BECKET.  
SILK CLOTH DISC.  
SILK BRAID LOOP



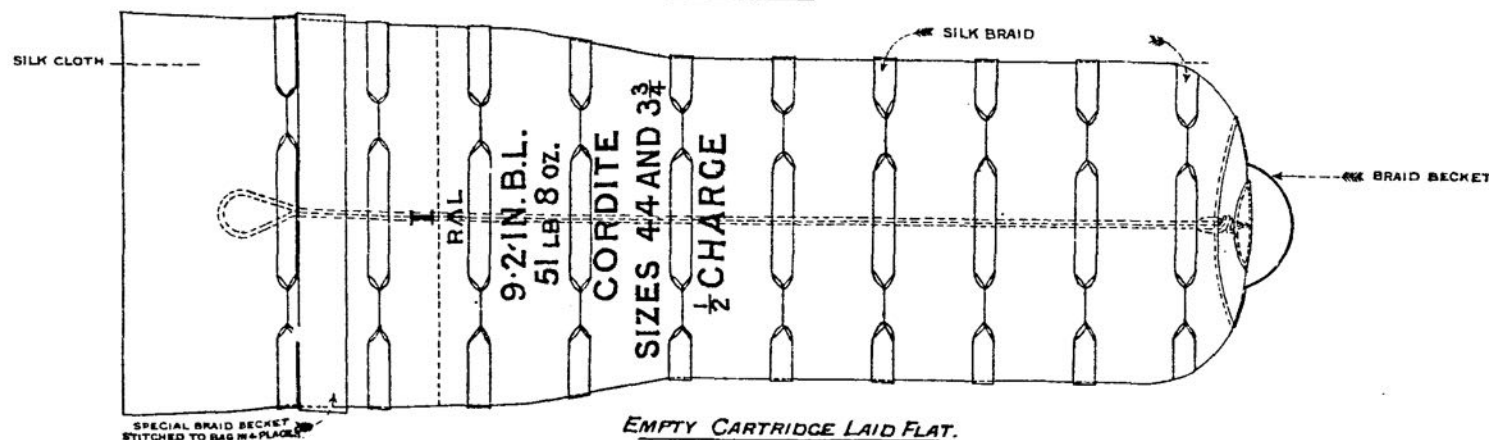
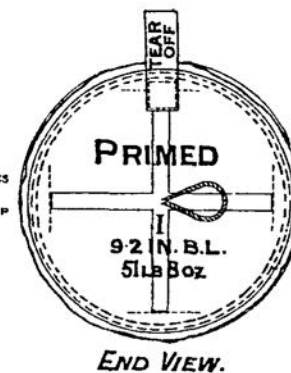
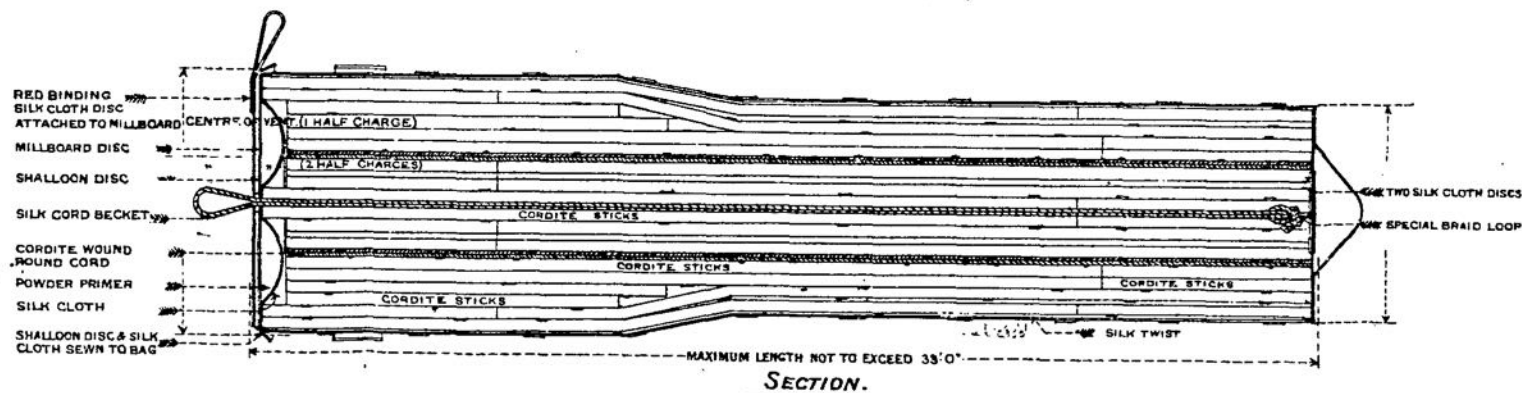
END ELEVATION.



**CARTRIDGE, B.L., 9.2 INCH, 51 LB. 8 OZS., CORDITE SIZES 44 & 3 3/4, MARK I.**

**SILK CLOTH, 49 LB. 8 OZ. SIZE 44, & 2 LB. SIZE 3 3/4. 1/2 CHARGE. MARKS IX & X GUNS.**

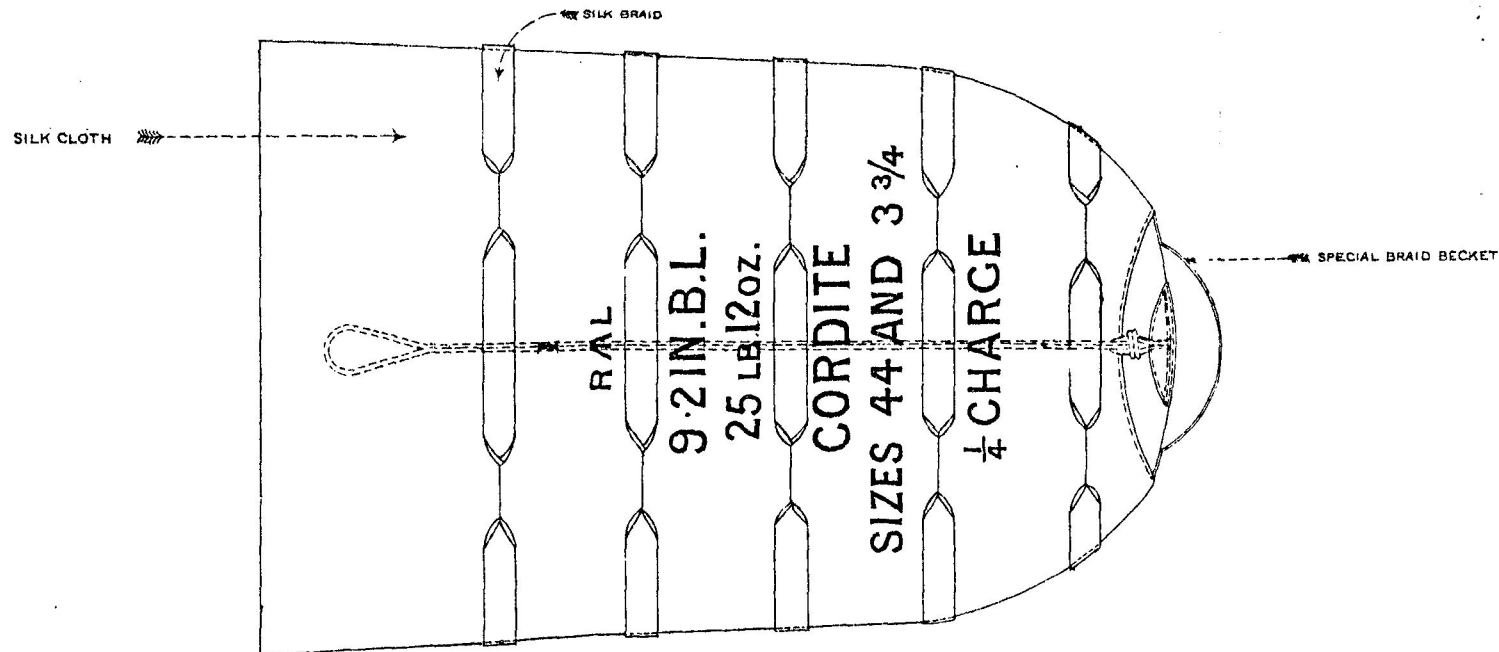
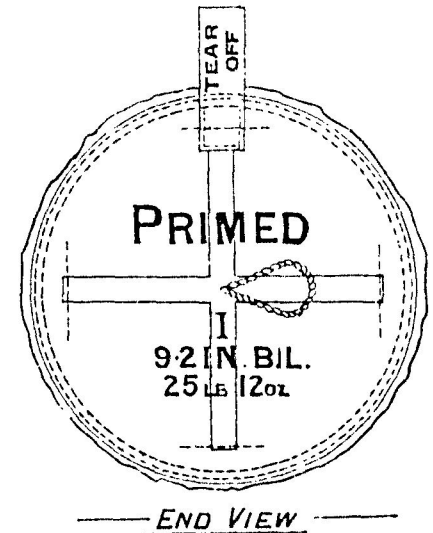
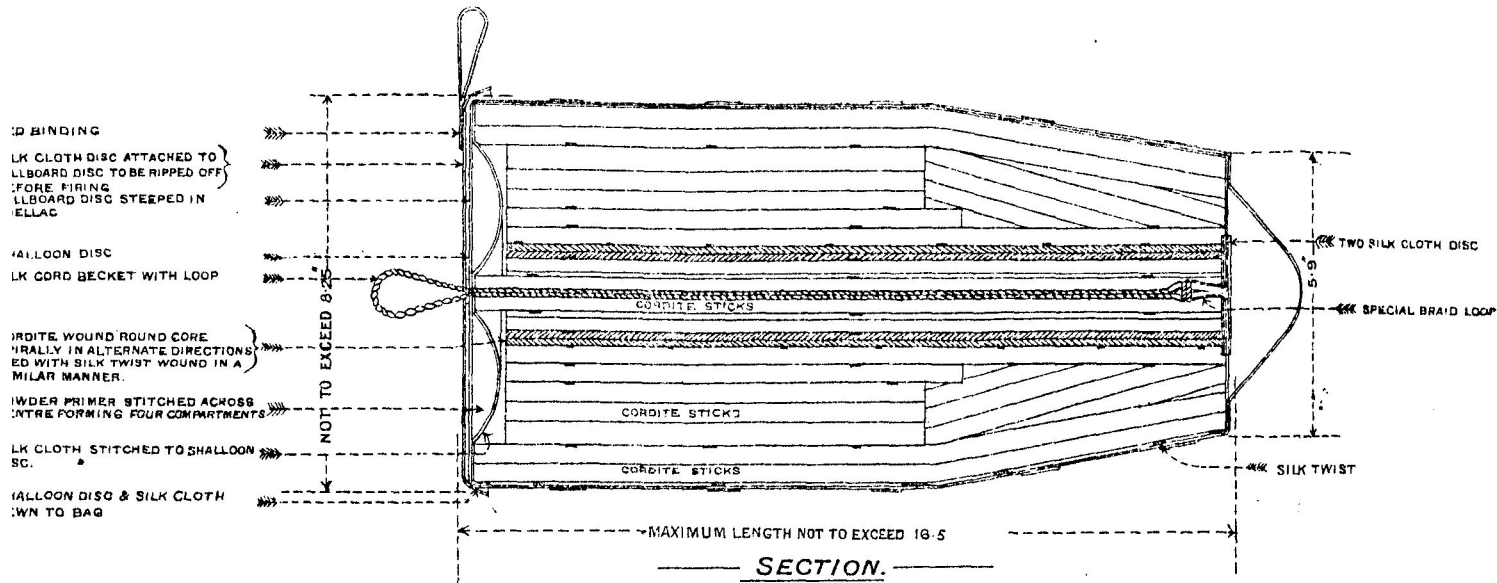
SCALE 1/6.



# CARTRIDGE, B.L. 9.2 INCH, 25LB. 12OZ. CORDITE SIZES 44 & 3 3/4, MARK I.

SILK CLOTH, 24 LB. 12 OZ. SIZE 44 & 1 LB SIZE 3 3/4. 1/4 CHARGE. MARKS IX & X GUNS.

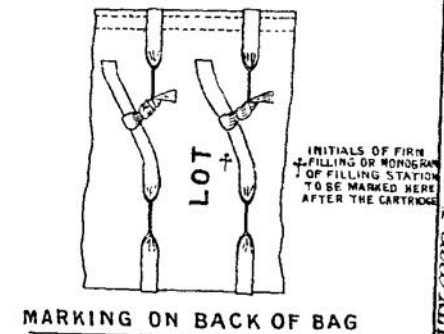
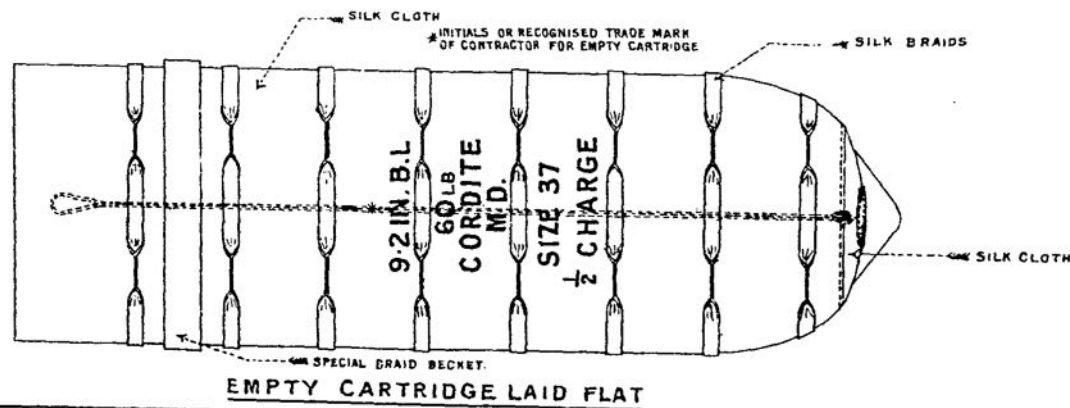
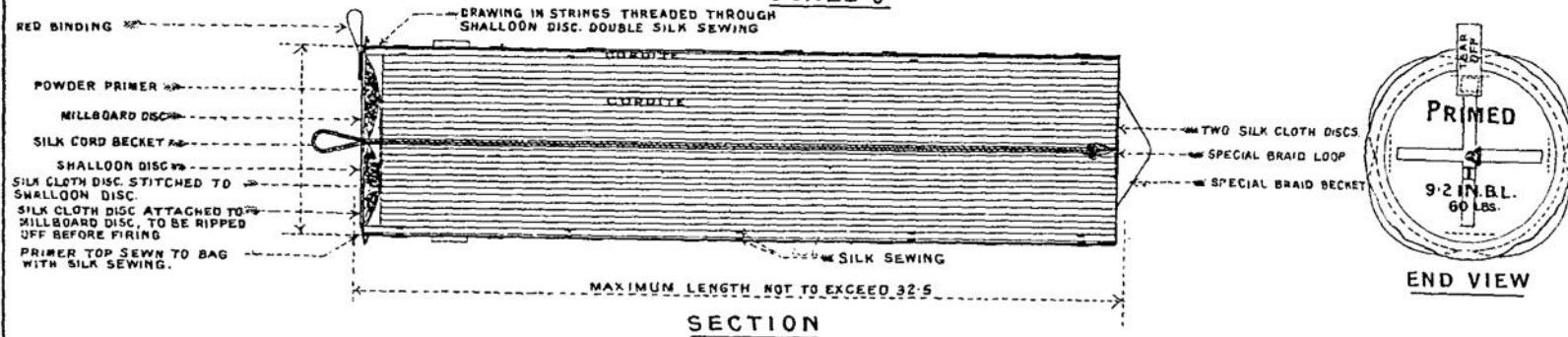
SCALE 1/4



# CARTRIDGE. B. L. 9.2 INCH, 60 LB. CORDITE M.D. SIZE 37, MARK I.

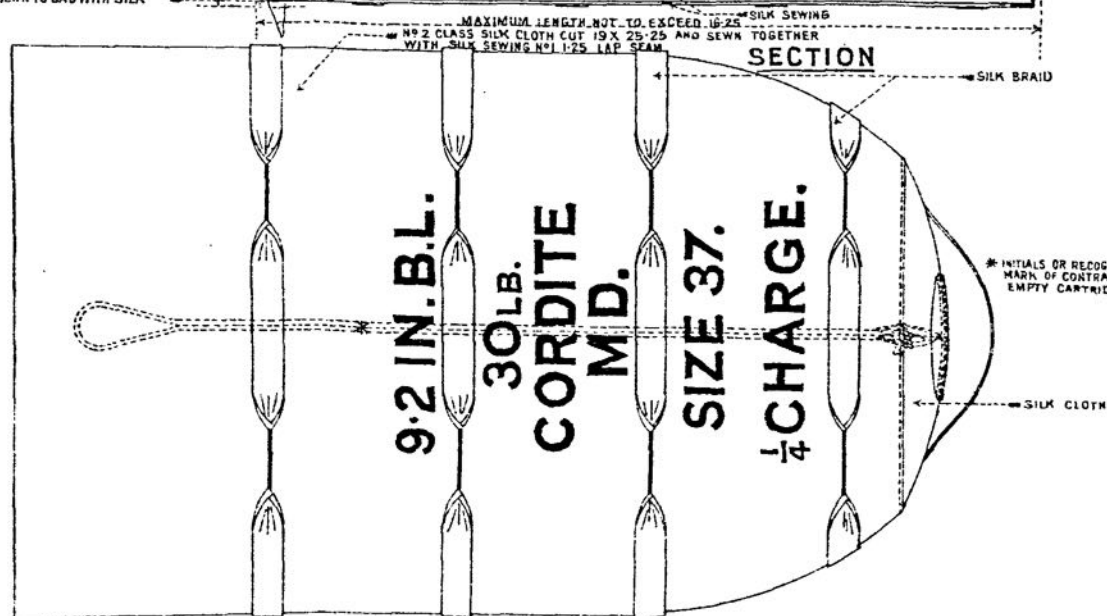
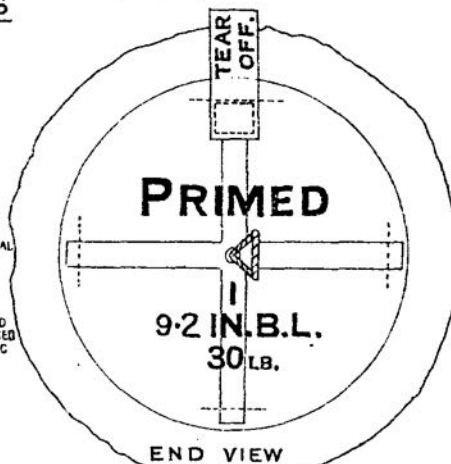
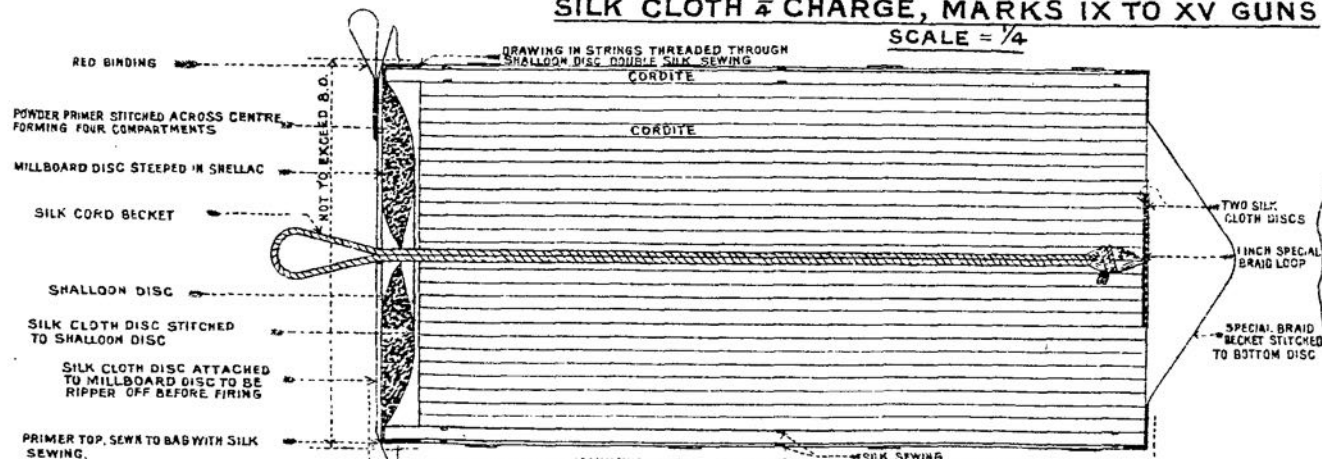
SILK CLOTH;  $\frac{1}{2}$  CHARGE, MARK IX, TO XV GUNS.

SCALE  $\frac{1}{8}$

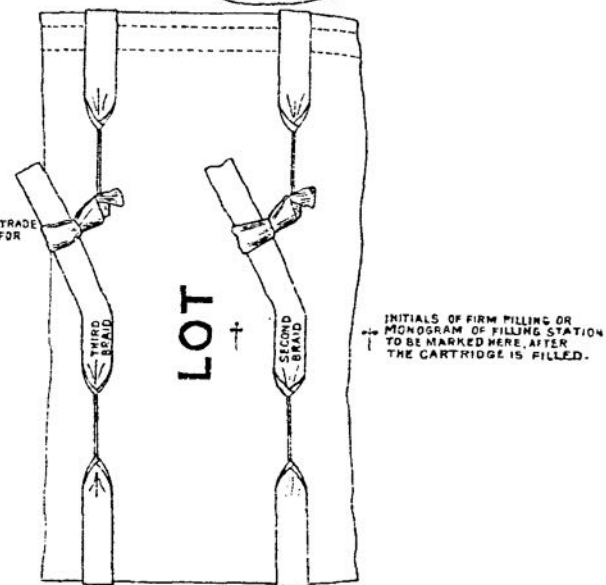


# CARTRIDGE, B.L. 9.2 INCH, 30 L.B. CORDITE M.D. SIZE 37, MARK I SILK CLOTH $\frac{1}{4}$ CHARGE, MARKS IX TO XV GUNS

SCALE =  $\frac{1}{4}$



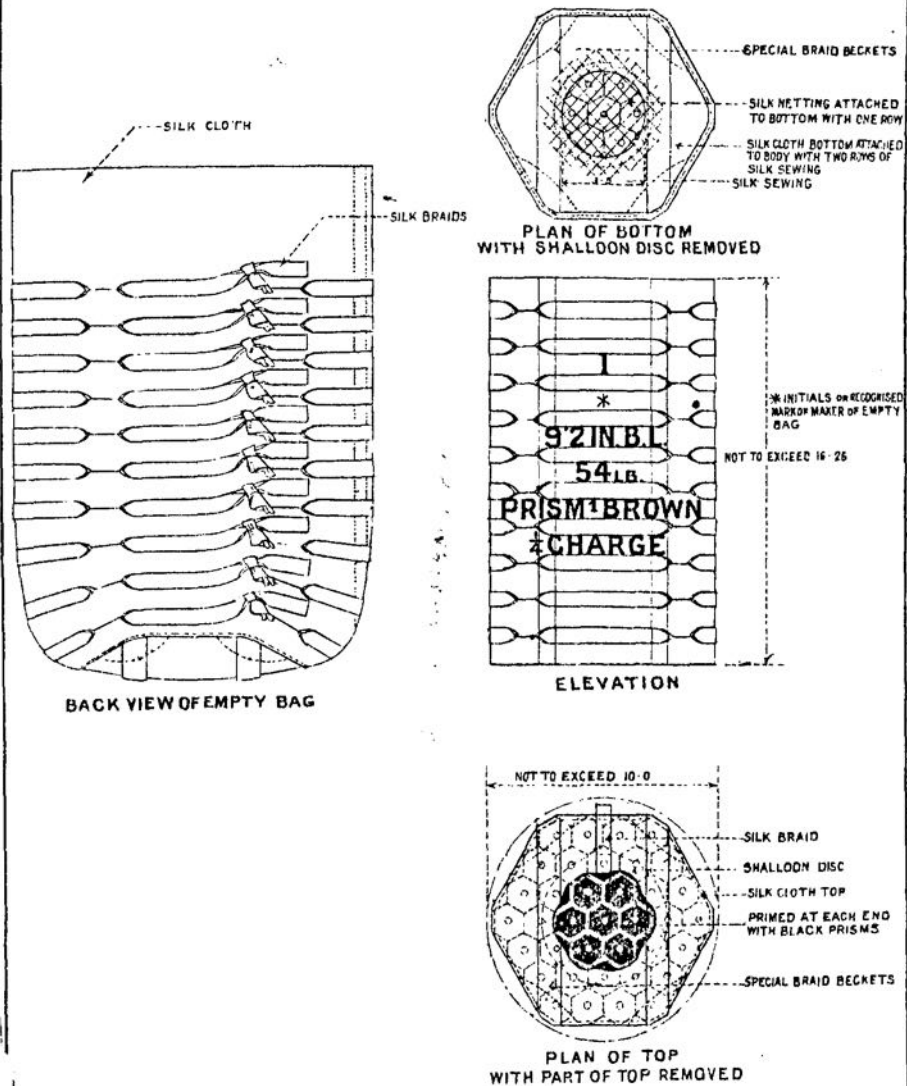
EMPTY CARTRIDGE LAID FLAT



MARKING ON BACK OF BAG

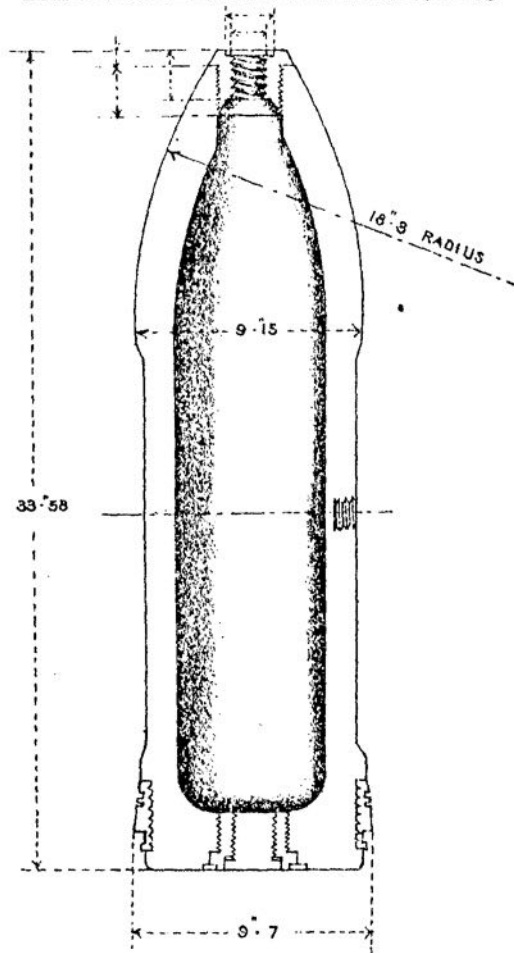
**CARTRIDGE B. L. 9.2 INCH 54 LB. PRISM BROWN MARK I**  
**SILK CLOTH:  $\frac{1}{4}$  CHARGE, FOR PAPER SHOT, MARK X GUN.**

SCALE  $\frac{1}{8}$



SHELL, B.L., COMMON, 9.2 INCH.  
CAST STEEL, MARK V.C

COMMON, CAST STEEL, MARK V.

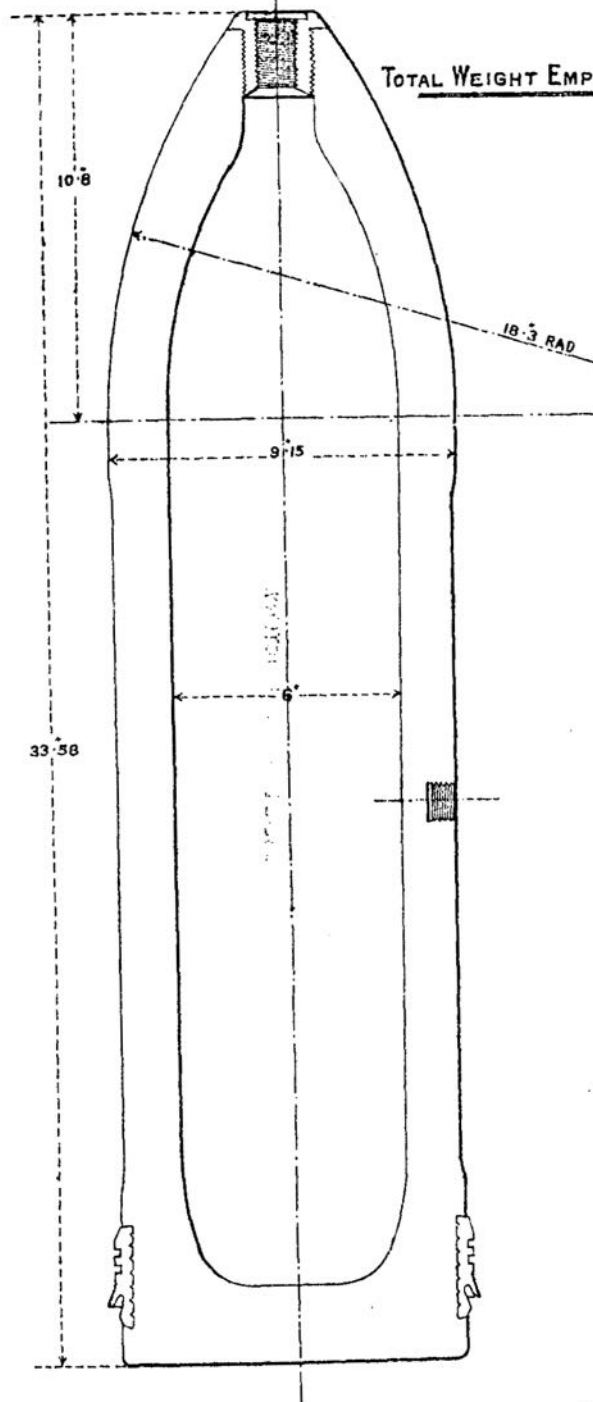




SHELL, B. L., LYDDITE, COMMON, 9.2 INCH HEAVY, (MARK II) L.  
FORGED STEEL.

SCALE 1/5.

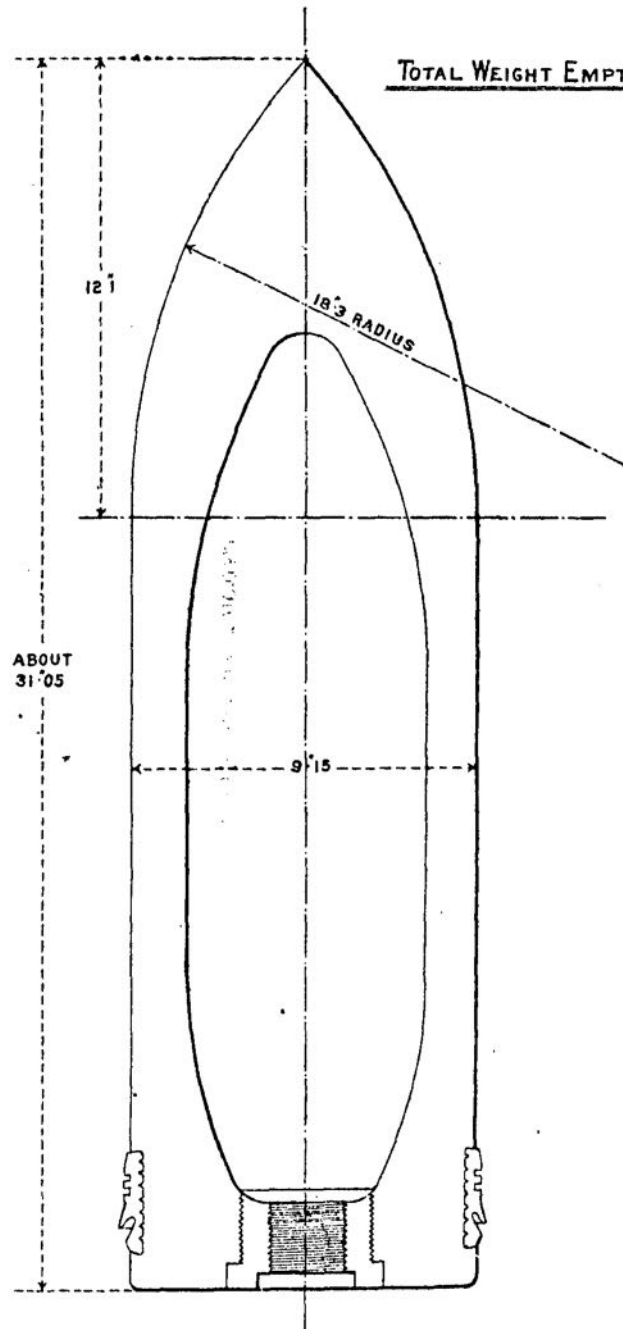
TOTAL WEIGHT EMPTY. <sup>LB.</sup> 339. <sup>OZ.</sup> 6



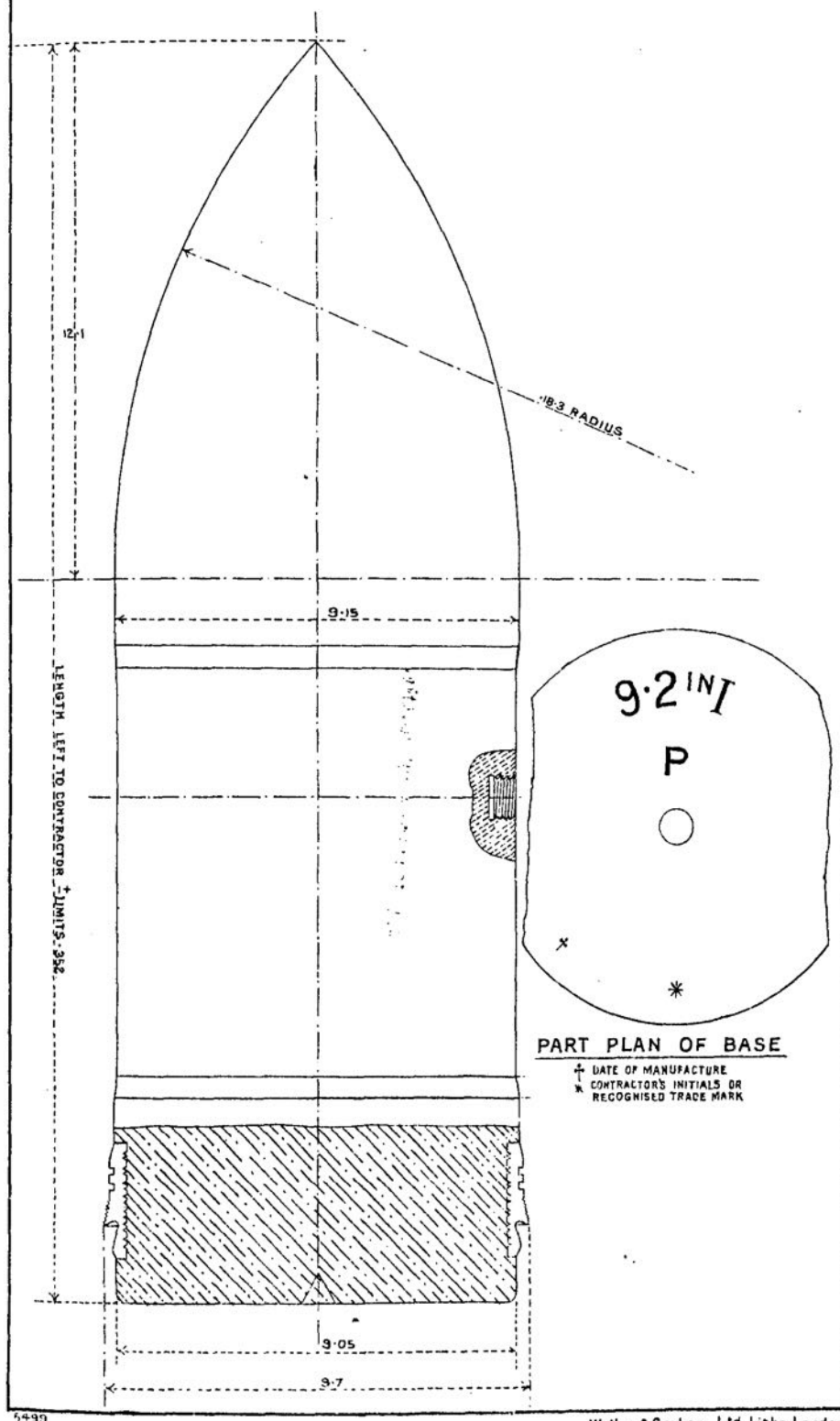
SHELL, B.L. ARMOUR PIERCING, 9.2 INCH. (MARK II). [C.]  
STEEL; FOR LARGE BASE FUZE.

SCALE 1/5.

TOTAL WEIGHT EMPTY. 359 <sup>LB</sup> 8 <sup>OR</sup>

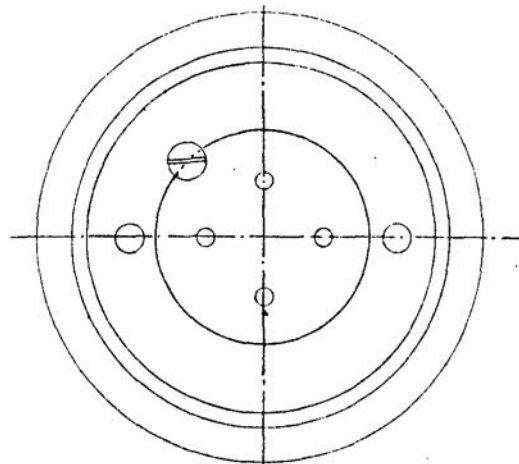


# SHOT SOLID, B.L. 9.2 INCH. MARK I IRON PRACTICE

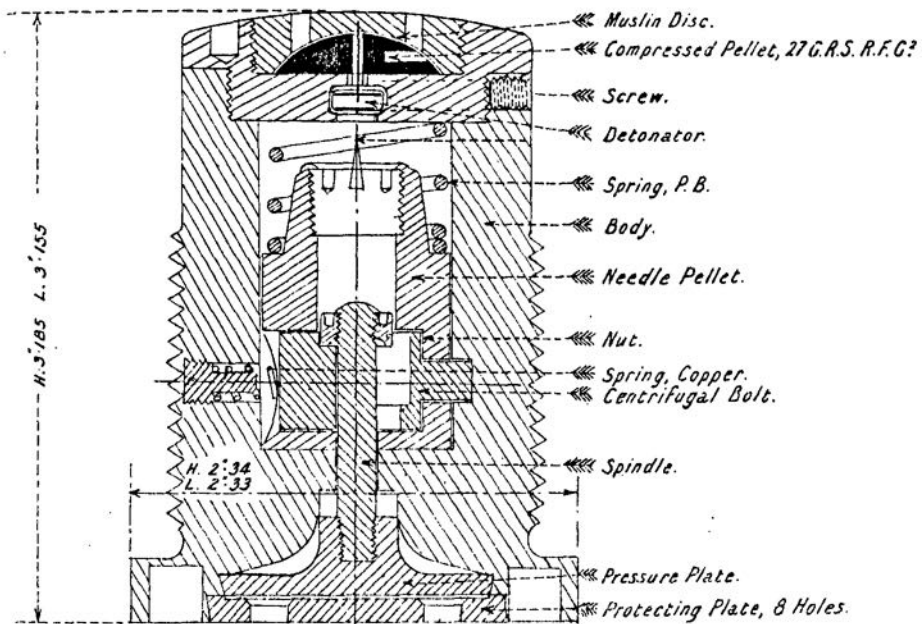


FUZE, PERCUSSION, BASE, LARGE N° II, (M<sup>K</sup> IV) |C|.

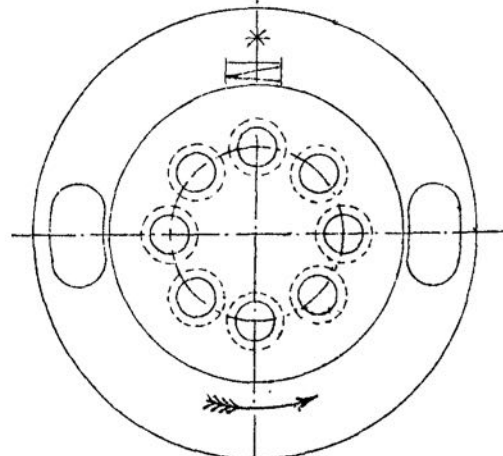
FULL SIZE.



TOP PLAN.

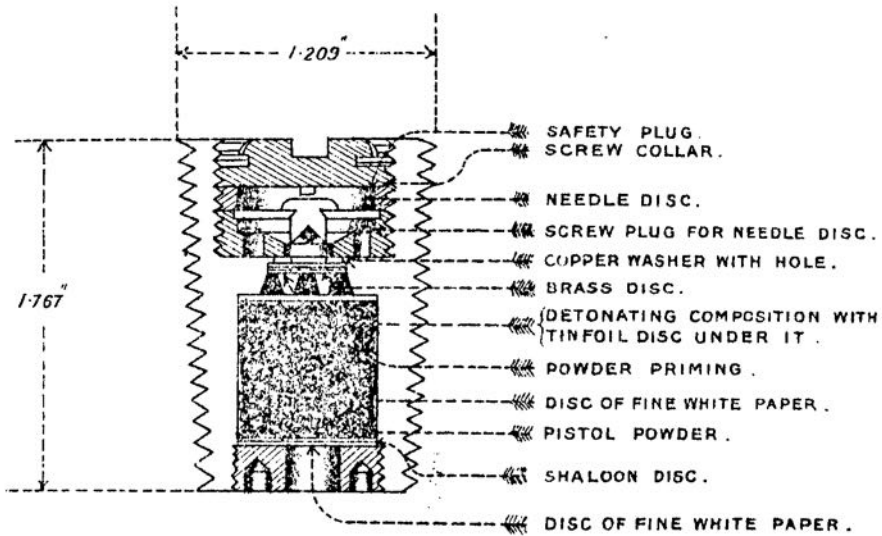


SECTIONAL ELEVATION.

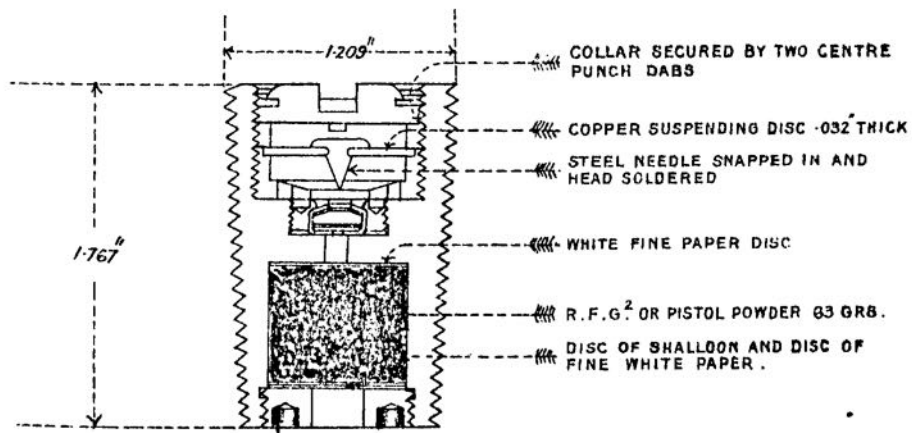


PIN OF BISE

FUZE, PERCUSSION DIRECT ACTION, N° 3,  
WITH PLUG  
FULL SIZE  
MARK III.



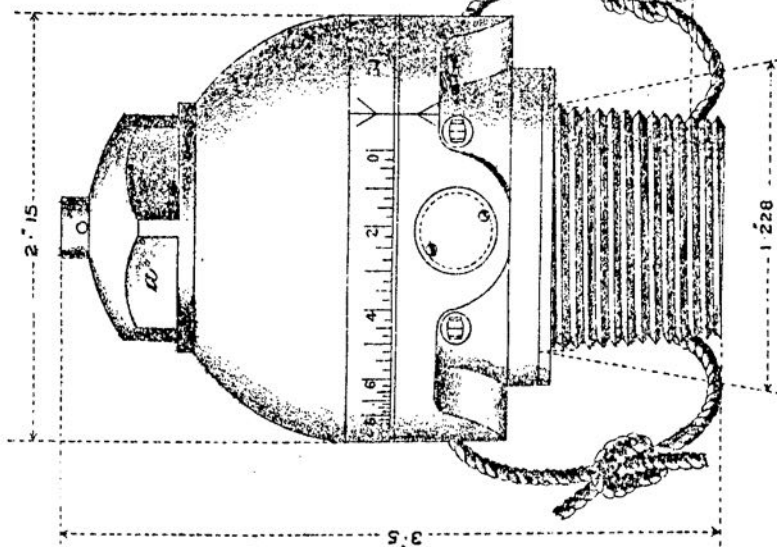
MARK IV.



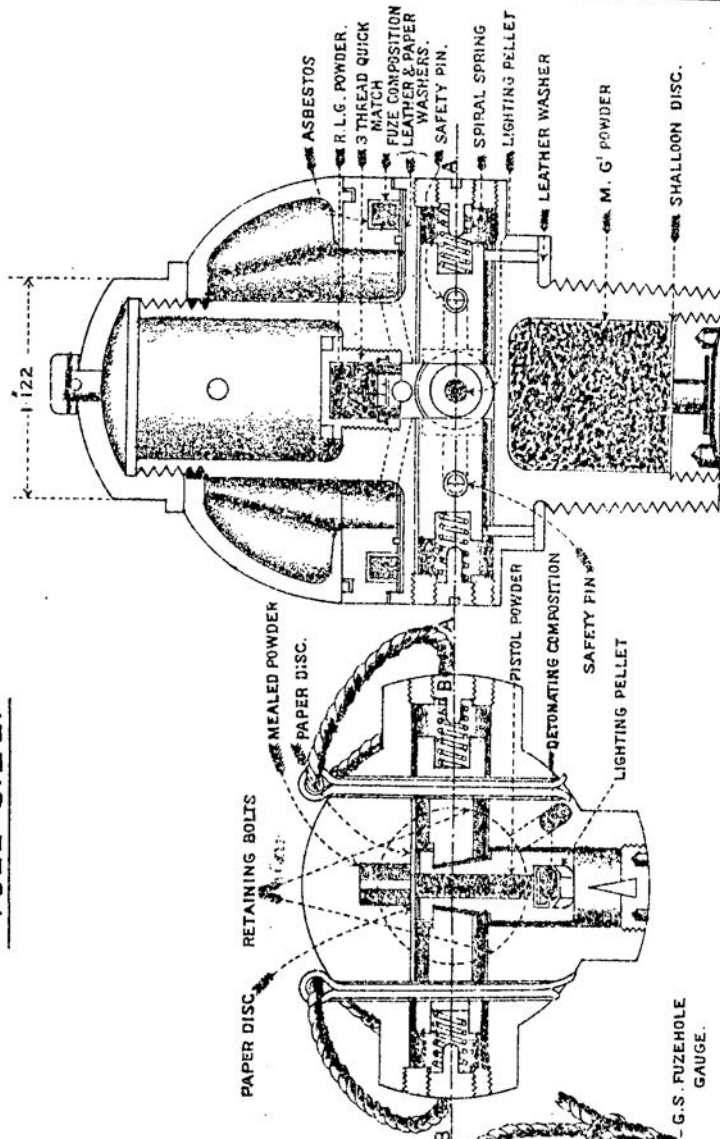
FULL SIZE

# FUZE, TIME, SENSITIVE MIDDLE, N° 24, MARK I.

FULL SIZE.



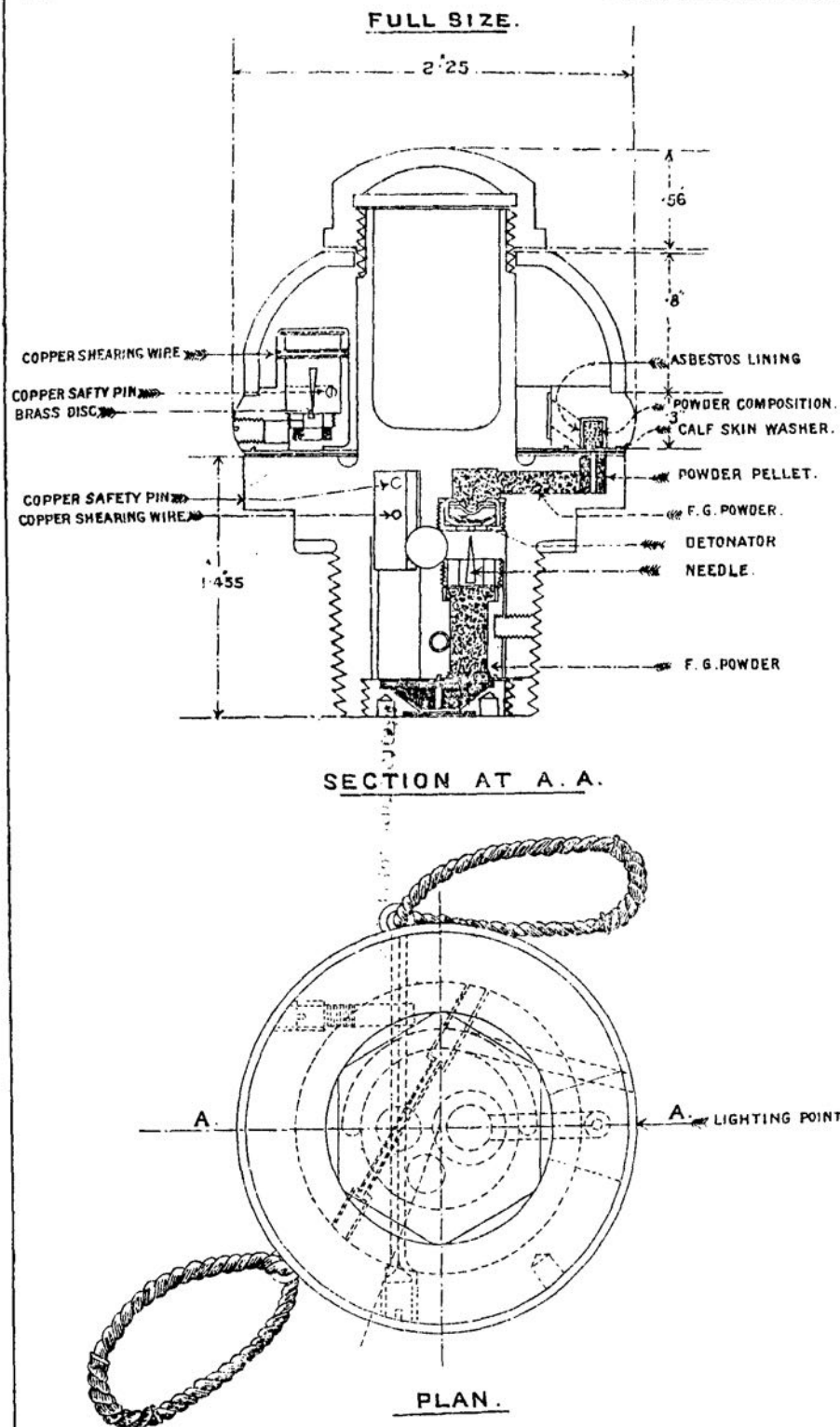
ELEVATION SET AT SAFETY.



SECTION AT A. A.

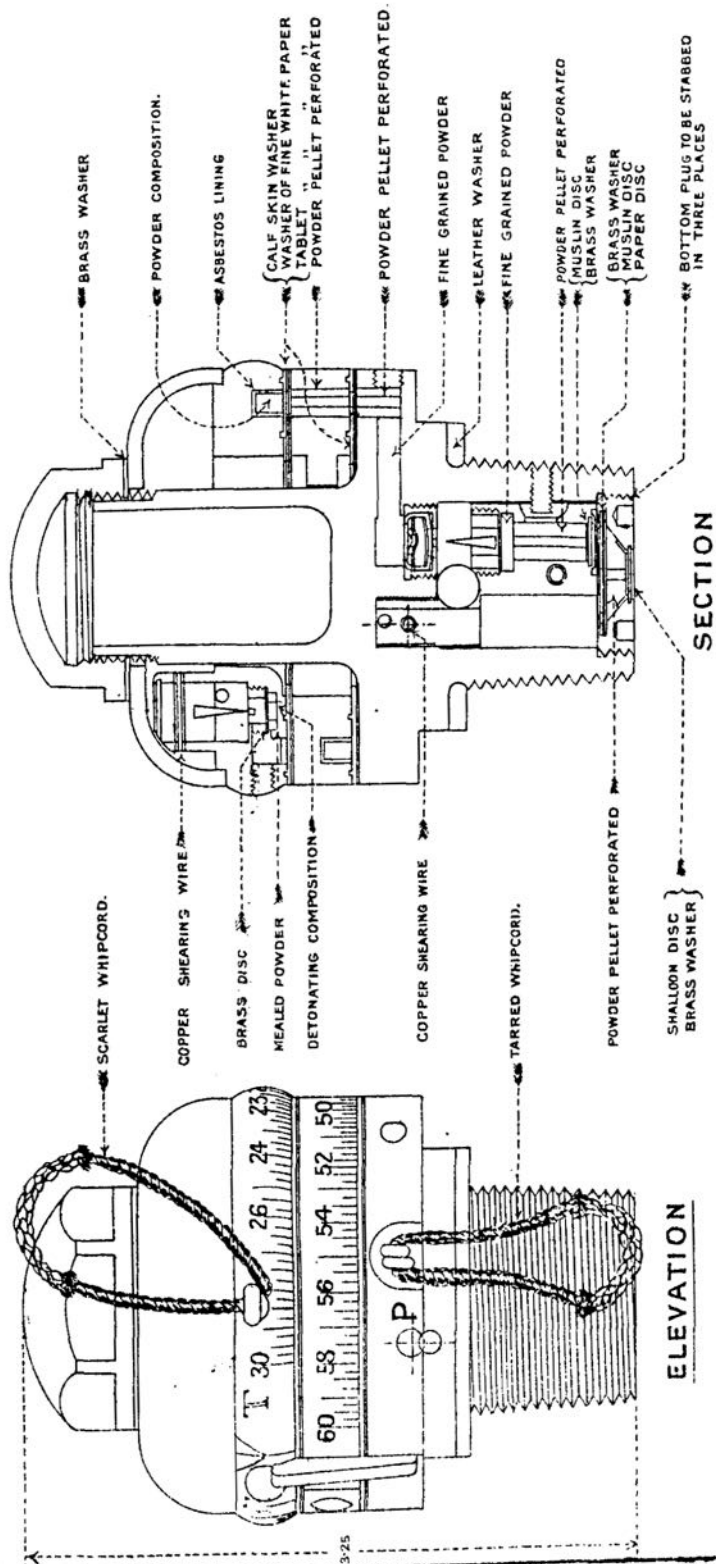
SECTION AT B. B.

FUZE, TIME AND PERCUSSION, MIDDLE, N<sup>o</sup> 54, MARK III.



# FUZE, TIME, AND PERCUSSION N° 62, MARK I.

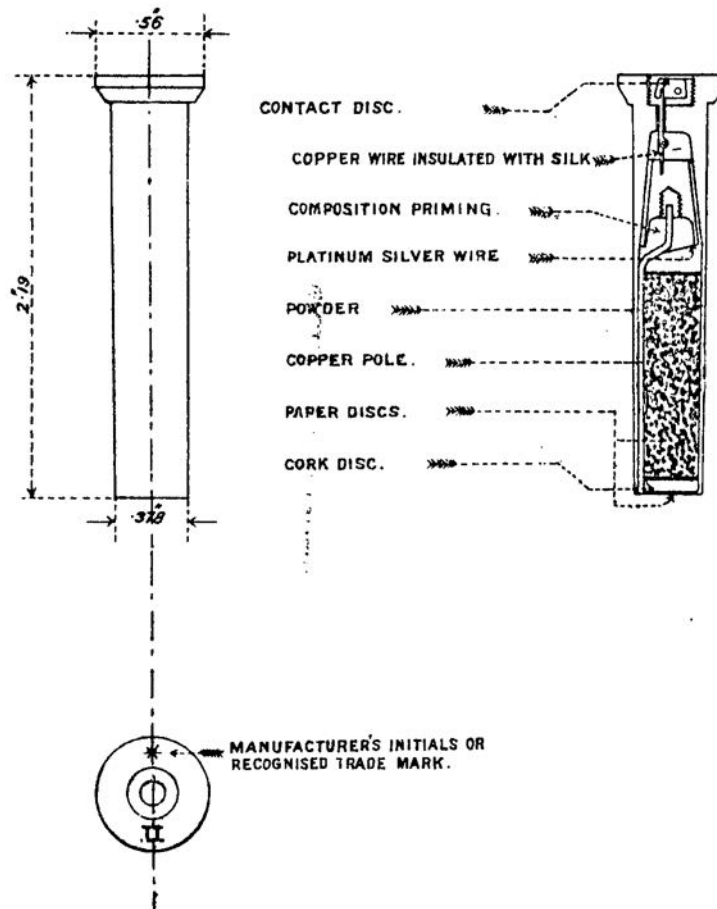
SCALE = 1/4.





# TUBE, VENT-SEALING, ELECTRIC, WIRELESS, P, MARK II.

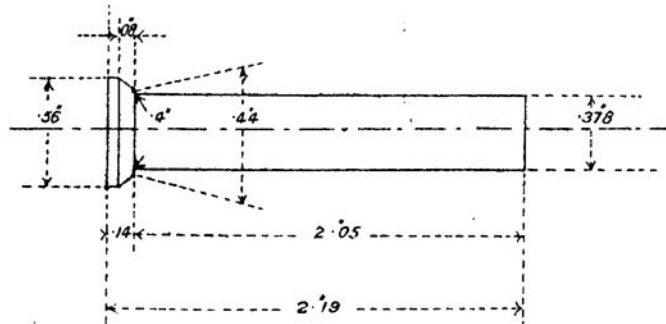
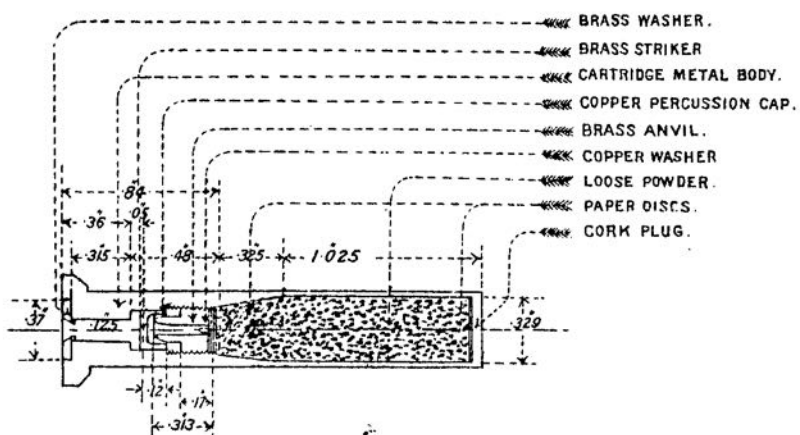
BRASS.



# TUBE, VENT-SEALING, PERCUSSION, MARK II.

BRASS, FOR GUNS WITH PERCUSSION LOCKS.

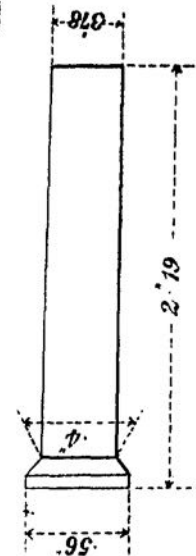
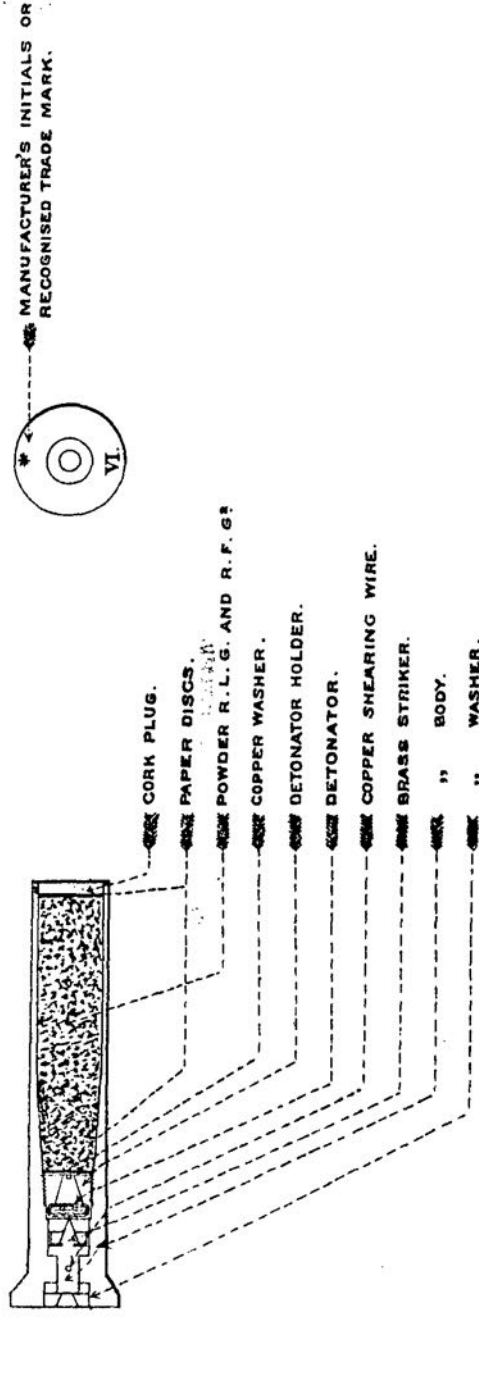
FULL SIZE.



# TUBE, VENT SEALING, PERCUSSION, MARK VI.

BRASS.

FULL SIZE.



# TUBE, VENT SEALING, PERCUSSION. DRILL, MARK II.

FULL SIZE.

